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STRONG-MOTION RECORDS FROM THE LIVERMORE EARTHQUAKE OF 24 AND 26 JANUARY 1980

1980

CALIFORNIA DIVISION OF MINES AND GEOLOGY

PRELIMINARY REPORT 28

STATE OF CALIFORNIA
EDMUND G. BROWN JR.
GOVERNOR

THE RESOURCES AGENCY
HUEY D. JOHNSON
SECRETARY FOR RESOURCES

DEPARTMENT OF CONSERVATION
PRISCILLA C. GREW
DIRECTOR

DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS
STATE GEOLOGIST

PRELIMINARY REPORT 28

STRONG-MOTION RECORDS FROM THE LIVERMORE EARTHQUAKE OF 24 AND 26 JANUARY 1980

1980

R.D.McJUNKIN
J.T.RAGSDALE

OFFICE OF STRONG MOTION STUDIES
CALIFORNIA DIVISION OF MINES AND GEOLOGY
2811 'O' STREET
SACRAMENTO, CA 95816

California Division of Mines and Geology
1416 Ninth Street, Room 1341
Sacramento, Ca 95814

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INTRODUCTION

This report summarizes California Division of Mines and Geology (CDMG), Strong Motion Instrumentation Program (SMIP) accelerograph records recovered from the 24 and 26 January 1980 Livermore earthquakes. All CDMG accelerograph stations that were triggered by the earthquakes are listed in table I and II. These stations with their respective ground accelerations and other pertinent earthquake data are arranged in order of increasing epicentral distance in table III and IV. Response data for structures instrumented by SMIP are presented in table V and VI. All records from CDMG stations recording 0.05 g or greater ground acceleration are determined to be significant (Porter and Real, 1979; CDMG, 1979) and are reviewed in detail.

Epicentral data from the January 1980, Livermore earthquakes are provided by UC Berkeley and the USGS Menlo Park. However, the USGS operates the most concentrated seismic instrument network in proximity to the earthquake region; for this reason, USGS epicentral data are used in this report unless otherwise specified.

Earthquake records from the Livermore events will eventually be digitized and processed and made available in a CDMG special publication. Digitizing and processing of earthquake records is prioritized by demand from the user community and relative merits of records in the backlog.

Acknowledgements

CDMG extends appreciation to those building owners, agencies and organizations that have permitted installation of Office of Strong-Motion Studies (OSMS) strong-motion equipment on their property. We also wish to thank Albert (Gene) Guyer, Charles (Ed) Luzier and Charles Turpen for their quick response in record retrieval and station maintenance after the earthquakes and Marvin Huston for assistance in compiling earthquake record data used in this report.

Cautionary Note on Use of Data

This preliminary data compilation has not been edited or reviewed for conformity with standards and nomenclature of CDMG. Reasonable precautions have been taken to ensure accuarcy of material presented, however, the preliminary nature of the data makes them all subject to change upon further verification. Distortions from reproduction of earthquake records in this report make these copies unsuitable for measurements or scalings. Accurate photographic copies of original records may be obtained from: California Division of Mines and Geology, Office of Strong Motion Studies, 2811 "O" Street, Sacramento, California 95816.

Abbreviations

Organizations

CDMG	California Division of Mines and Geology
OSMS	Office of Strong-Motion Studies
SMIP	Strong Motion Instrumentation Program
USGS	United States Geological Survey
UCB	University of California Berkeley

Instruments

CRA-1	Central Recording Accelerograph (Kinemetrics, Inc.) [film]
FBA	Force-balance accelerometer (Kinemetrics, Inc.)
RFT-250	Triaxial accelerograph (Teledyne Corporation) [film]
SMA-1T	Triaxial accelerograph with WWVB radio receiver (Kinemetrics, Inc.) [film]

Product Disclaimer

Product trade names or trademarks used in this publication are intended for descriptive purposes only. Such use does not constitute endorsement by the California Division of Mines and Geology.

Instrument Orientations

Direction	Upward trace movement on film record indicates positive acceleration in the listed azimuth direction.
Stations not in Structures	Orientation is in degrees azimuth (clockwise from north).
Stations in Structures	Orientation is in quadrant notation with respect to a reference north.

LIVERMORE EARTHQUAKES

Moderate-magnitude earthquakes occurred in the east-central Coast Ranges near Livermore, California on 24 and 26 January 1980. The 24 January earthquake (M_L = 5.5, UCB Seismographic Station and M_L = 5.9, USGS Menlo Park) originated at 11:00:9.46 Pacific Standard Time (PST) approximately 16 km north of Livermore in the northeastern Diablo Range (Figure 1). UC Berkeley places the 24 January main shock epicenter near latitude 37.85°N and longitude 121.82°W at a focal depth of 11.4 km. USGS Menlo Park epicentral coordinates for the same event are 37.84°N and 121.80°W at a focal depth of 5.9 km. A magnitude 2.7 foreshock preceded the 24 January main shock by 87 seconds and magnitude 5.2 and 4.2 aftershocks occurred 52 and 97 seconds respectively after the main event (Bolt and others, 1980).

The 26 January earthquake (M_L = 5.8, UCB Seismograph Station and M_L = 5.2, USGS Menlo Park) originated at 6:33:35.96 PST approximately 6 km north-northeast of Livermore (Figure 2). UC Berkeley places the 26 January main shock epicenter in the vicinity of latitude 37.74°N and longitude 121.74°W at a focal depth of 14.5 km. USGS Menlo Park epicentral coordinates for this event are 37.76°N and 121.70°W at a focal depth of 7.3 km.

Damage from the earthquakes was minor. Reported damage, concentrated in Livermore, the closest community to the epicenters, was mostly non-structural and consisted of broken plate glass windows, cracked plaster, merchandise knocked from store shelves, and disturbed utilities. More severe damage was locally isolated. Many mobile homes were jolted from their foundation supports at

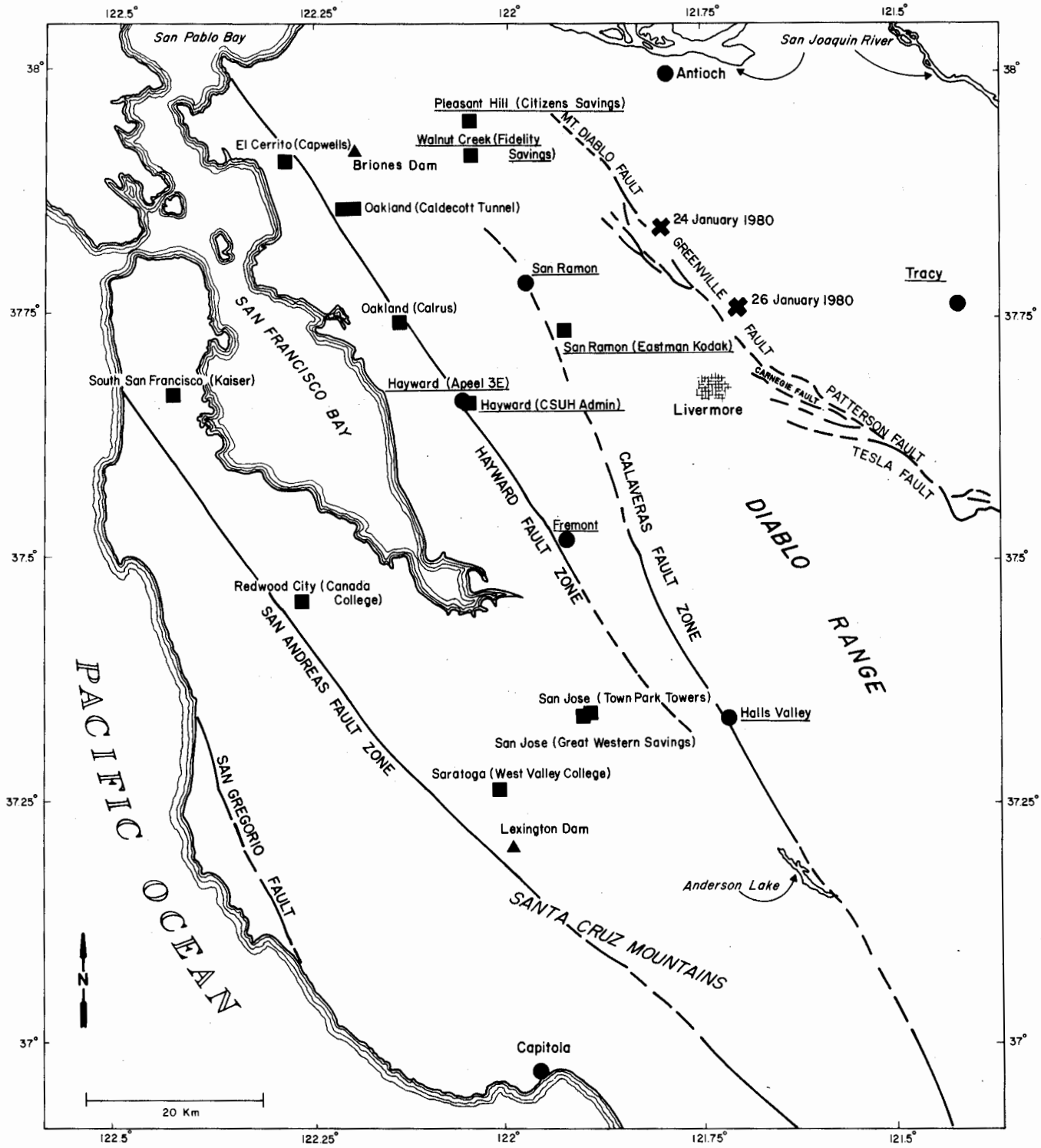

Figure 1. Region most affected by the 24 January 1980 Livermore earthquake. All CDMG strong-motion stations that were triggered and recorded the 24 January main shock are plotted. Closed circles are permanent freefield stations, squares are instrumented buildings, triangles are instrumented dams and the rectangle is an instrumented tunnel. Names of stations that recorded significant (>0.05 g) ground motion are underlined. Main shock epicenters and the Mt. Diablo-Greenville fault system are noted. Fault data modified after Jennings and Strand (1958), Jennings and Burnett (1961), and Rogers (1966).

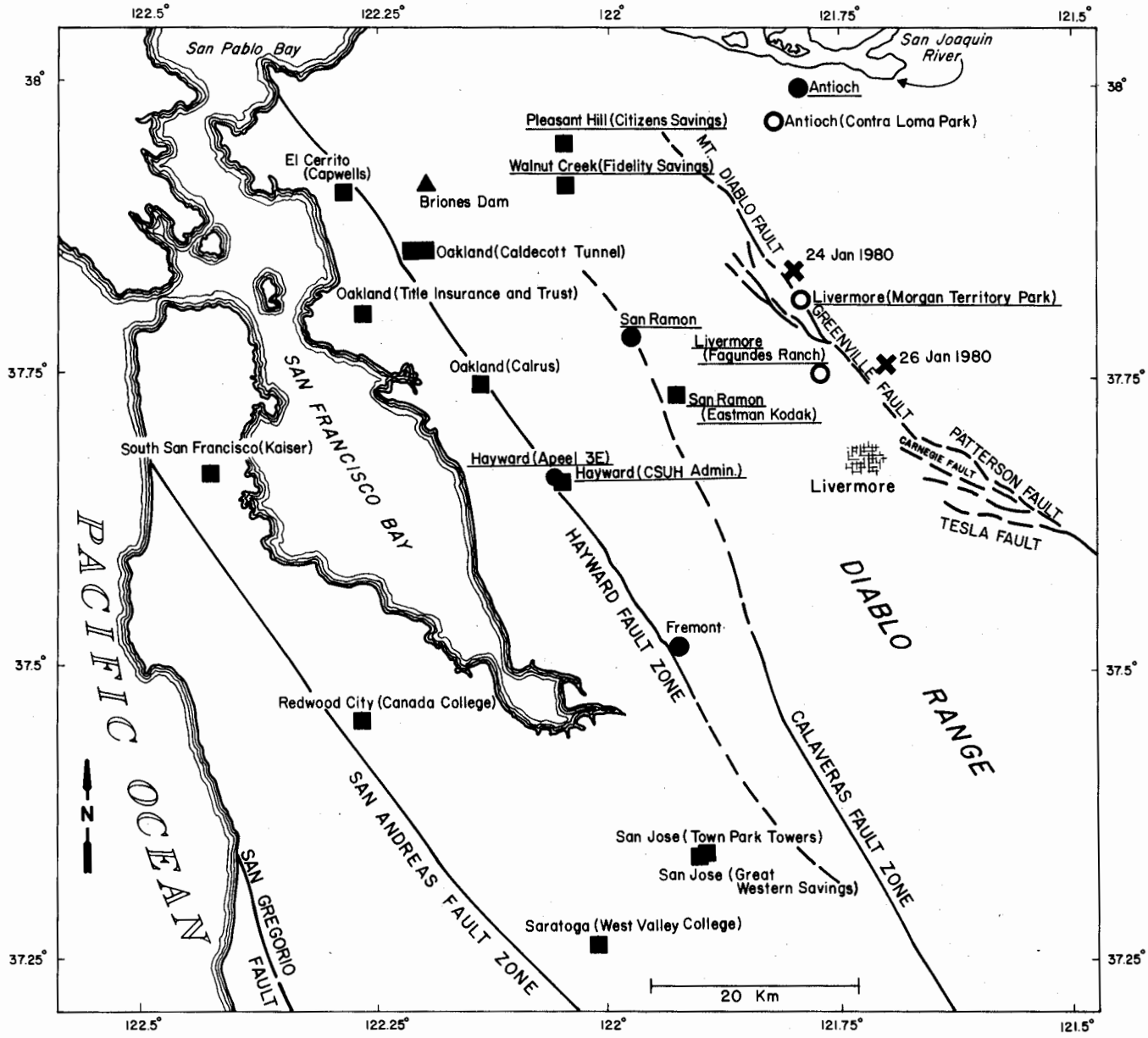

Figure 2. Region most affected by the 26 January 1980 Livermore earthquake. All CDMG strong-motion stations that were triggered and recorded the 26 January main shock are plotted. Closed circles are permanent freefield stations, open circles are temporary freefield stations instrumented in response to the 24 January earthquake, squares are instrumented buildings, the triangle is an instrumented dam, and the rectangle is an instrumented tunnel. Names of stations that recorded significant (>0.05 g) ground motion are underlined. Main shock epicenters and the Mt. Diablo-Greenville fault system are noted. Fault data modified after Jennings and Burnett (1961) and Rogers (1966).

a mobil home park in Livermore. The Interstate 580 bridge crossing Greenville Road suffered settlement in abutment fill of the eastern approach; the bridge sustained no structural damage and was back in operation after filling areas of settlement and resurfacing the roadway. The highest dollar loss to single installations occurred at Lawrence Livermore Laboratory and Wente Brothers Livermore Winery. Non-structural damage to Lawrence Livermore Laboratory is estimated to be $15,000,000 which mostly includes broken plumbing and glass. No damage was reported at structures or facilities housing radioactive material. At Wente Brothers Livermore Winery more than 80 percent of the wine tanks suffered some degree of damage; many stainless steel wine tanks were overturned by collapse of structural supports during ground shaking.

The 24 and 26 January Livermore earthquakes were generated by right-lateral strike-slip and partial dip-slip movement (Bolt and others, 1980) on the northwest-southeast trending Greenville-Mt. Diablo fault system. These faults are exposed cutting predominantly Cretaceous Great Valley Sequence and younger Cenozoic rocks in the northern Diablo Range (Rogers, 1966). Mapping by Brabb and others (1971) subdivides the Mt. Diablo fault into individually shorter segments named the Marsh Creek, Morgan Territory, and Clayton Faults.

The Livermore earthquakes generated approximately 6 km of discontinous surface rupture along the northern portion of the Greenville fault (Bedrossian and others, 1980). Maximum observed right-lateral surface offset after the 26 January event varies from 2 cm (Bedrossian and others, 1980) up to 5 cm (Bolt and others, 1980). A maximum dip-slip offset of 13 cm was observed with vertical displacement up on both the northeast and southwest sides of

the fault in different places (Bedrossian and others, 1980).

The Greenville-Mt. Diablo fault system exhibits major right-lateral and minor dip-slip offset. Movement on these faults is generated by tectonic mechanisms responsible for displacement of the San Andreas fault located approximately 70 km to the west. The San Andreas fault is defined as a transform boundary that separates Pacific and American plates (Atwater, 1970). Relative northward movement of the Pacific plate past the American plate provides motion for generating right-lateral displacement on many fault zones in northern California.

GEOLOGIC SETTING

The region most affected by the 24 and 26 January Livermore earthquakes is situated in the northern Diablo Range of California. The Diablo Range, occupying the east-central part of the natural geomorphic Coast Ranges Province, trends northwest-southeast and is bounded by the Calaveras fault zone on the west and San Joaquin Valley on the east.

Franciscan Formation (melange after Hsu, 1966, 1971; Blake and Jones, 1974) underlies most of the northern Diablo Range. Franciscan rocks contain Late Jurassic to Late Cretaceous fossils (Bailey and others, 1964) and comprise the oldest terrane in the areas local to the 24 and 26 January earthquakes. Franciscan rock types in this region include volcanic sandstone and siltstone, graywacke, chert, minor conglomerate, serpentine, and greenstone. Structure in these rocks is locally preserved; however, on a regional scale it is chaotic. Plate tectonic models for development of western North America suggest that Franciscan melange is a trench deposit that accumulated in an active subduction zone adjacent on the west to Mesozoic California (Bailey and others, 1970; Ernst, 1970; Page, 1970). Between 9,000 m and 15,000 m of rock are estimated to comprise the total thickness of Franciscan melange (Bailey and others, 1964).

Great Valley Sequence in the northern Diablo Range and hills east of San Francisco Bay consists of Cretaceous sandstone, siltstone, shale, and conglomerate that are assigned by researchers to several formations. Contacts

between Great Valley Sequence rocks and older Franciscan terrane are everywhere faulted in the northern Diablo Range (Huey, 1948; Crittenden, 1951; Maddock, 1964; Rogers, 1966). Rocks of the Great Valley Sequence generally strike northwest and dip moderately to steeply northeast and southwest. This structural orientation helps define the tectonic and geomorphic fabic of the region. Great Valley rocks accumulated as arc-trench gap deposits east of the subduction zone where Franciscan melange was forming and west of the late Mesozoic volcanic continental arc (Dickenson, 1974; Ingersoll, 1978). The influx of continental sediment into the arc-trench gap, much of which was transported into deeper water by turbidity currents, formed a broad continental shelf by Late Cretaceous time. These shelf deposits comprise approximately 7,600 m of stratigraphic thickness in the northern Diablo Range (Maddock, 1964) and are up to 1,800 m thick in the hills east of San Francisco Bay (Lawson, 1914).

Franciscan and Great Valley Sequence rocks are overlain by early to late Cenozoic sandstone, siltstone, shale and conglomerate with local interbeds of bitumenous shale in the hills east of San Francisco Bay (Lawson, 1914) and coal in the northern Diablo Range (Rogers, 1966). These sediments were deposited in a marine and brackish-water environment as shallow continental shelf and deltaic deposits; depositional conditions were similar to those where the Great Valley Sequence accumulated. Submarine canyons, now exposed as backfilled large-scale channels, directed turbidity currents that transported vast quantities of sediment into deeper water (Fisher, 1979). Between

1,700 m (Huey, 1948) and 2,400 m (Crittenden, 1951) of early to late Cenozoic sediment was deposited in the present region of the northern Diablo Range and up to 6,100 m (Lawson, 1914) in regions east of San Francisco Bay.

Pleistocene continental deposits are locally draped over older rocks in the northern Diablo Range. These deposits include loosely consolidated sand, gravel, clay, and local tuff beds in Livermore gravel and fine-grained cross bedded sand with interbedded silt and clay in Tulare Formation (Huey, 1948; Rogers, 1966). Livermore gravel, comprising up to 1,400 m of section in the southern Livermore Valley (Huey, 1948), represents Pleistocene fanglomerate deposits. These deposits were shed primarily from Franciscan terrane into the ancestral Livermore Valley. Tulare Formation underlies the lower eastern slope of the northern Diablo Range adjacent to western portions of the San Joaquin Valley. These rocks represent older alluvium that was deposited in a fluvial environment.

Holocene alluvium is deposited in basins and along drainages throughout the region. Alluvium, consisting predominantly of sand, silt, and clay, is usually derived from local source rocks. Alluvial deposits in most places form flat or gently sloping surfaces that provide favorable locations for human development; consequently, many CDMG stations recording the 24 and 26 January earthquakes are underlain by alluvium in developed areas.

STRONG-MOTION DATA

Twenty-one CDMG accelerograph stations were triggered and recorded each of the 24 and 26 January Livermore earthquakes. Triggered CDMG stations include freefield locations to monitor ground motion and buildings and a tunnel to measure structural response. Records from these stations provide valuable response data that will be used to evaluate motion from earthquakes.

Ground Motion Data

Table I (Triggered Station Listing) and figure 1 lists the twenty-one CDMG accelerograph stations that were triggered and recorded the 24 January earthquake. The twenty-one CDMG accelergraph stations that were triggered by and recorded the 26 January earthquake, including three temporary stations instrumented in response to the 24 January event, are listed in table II (Triggered Station Listing) and figure 2; most of these stations recorded both Livermore earthquakes.

Nine CDMG stations produced significant earthquake records for each of the Livermore earthquakes (figures 1 and 2). The 24 January earthquake produced five significant records from CDMG freefield stations (Ground Motion Data) and four from instrumented structures (Structural Response Data). Three of these freefield stations are sited in one-story structures approximating a "freefield" condition and the other two are sited in pre-fabricated metal instrument shelters with approximate dimensions of 1.2 m x 1.2 m x 1.8 m. The 26 January earthquake also produced five significant records from CDMG freefield stations (Ground Motion Data) and four from instrumented structures (Structural Response Data).

Three of the freefield records are from one-story structures, one is from a pre-fabricated metal instrument shelter and the other is from an exposed concrete building slab. Two of these freefield stations are temporary sites placed in response to the 24 January event. Copies of significant freefield earthquake records and the respective station data for each site are presented in Ground Motion Data.

Table III (Ground Motion Data) lists ground motion data recorded at CDMG stations for the 24 January earthquake in order of increasing epicentral distance. All accelerographs that recorded significant strong-motion (0.05 g - Porter and Real, 1979; CDMG, 1979) of the 24 January earthquake are located at an epicentral distance of 56 km or less. The closest station with a significant record of this earthquake is San Ramon-Eastman Kodak Building at a distance of 16.7 km. Halls Valley-Grant Park, at an epicentral distance of 55.7 km, is the most distant CDMG station with a significant record.

Increasing epicentral station data for the 26 January earthquake are listed in table IV (Ground Motion Data). The temporary instrument site at Livermore-Fagundes Ranch is the closest CDMG station to this event at an epicentral distance of 6.3 km. Peak accelerations of the earthquake at this station are 0.22 g and 0.25 g horizontally and 0.10 g vertically. The next closest CDMG accelerograph to this event, with an epicentral distance of 11.0 km, is also from a temporary station instrumented in response to the 24 January earthquake at Livermore-Morgan Territory Park. A peak horizontal acceleration of 0.27 g was recorded at this location. The most distant CDMG significant record of the 26 January event is from Pleasant Hill-Citizens Savings Building at an epicentral distance of 38.1 km.

Ground accelerations recorded by CDMG strong-motion instruments of the

January 1980 Livermore earthquakes are common for moderate-magnitude earthquakes in this region (see, for example, Greensfelder, 1974; Porcella and others, 1979). West-central California is subject to high seismic intensity that could generate major damage from large-magnitude events (Alfors and others, 1973); bedrock accelerations of 0.5 g or greater are predicted for this region (Greensfelder, 1974). Acceleration records of the 24 and 26 January Livermore earthquakes collected by CDMG support published interpretations for the region.

Structural Response Data

Records obtained from structures are briefly summarized in Table V (Structural Response Data) for the 24 January earthquake and in Table VI (Structural Response Data) for the 26 January earthquake. The tables list station location, coordinates, structure type and size, instrument locations, and maximum accelerations for each structure. Where significant records were obtained, additional station data are provided; these data include structure description, instrumentation scheme, record data, and a copy of significant portions of the record.

The most significant record obtained during the 26 January event is from San Ramon-Eastman Kodak Building. This building is a single-story open industrial warehouse with exterior precast concrete shear walls and a metal roof diaphragm. The building sustained no major structural damage from the earthquakes. Peak accelerations of 0.28 g at ground level and 0.47 g at roof level during the 26 January event are well above minimum code design force levels. Records obtained during the earthquakes should provide useful data for studying the response of single-story industrial-type buildings at these higher force levels.

Three other instrumented buildings of various types and located farther from the 24 and 26 January epicenters were subjected to significant motion. No damage was reported at any of these structures. All are instrumented with central recorders in such a way that lateral and torsional response may be evaluated. It is expected that the data will be useful in further building response studies.

All significant records from buildings are being digitized. Corrected acceleration, velocity, displacement, and response spectra will be available to support additional analysis and interpretation.

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TRIGGERED STATION LISTING

TABLE I

Alphabetical list of CDMG strong-motion accelerograph stations that were triggered and recorded the 24 January 1980 Livermore earthquake.

No.	Station name	Coordinates	Site Geology	Structure Type/size	Instrument Location(s)
70	Antioch	38.015 N 121.813 W	alluvium ∿ 75 m	1-story & basement	ground level
183	Briones Dam	37.55 N 122.21 W	sandstone	earth dam	L. abutment L. & C. crest
125	Capitola	36.974 N 121.952 W	sandstone	1-story building	ground level
188	El Cerrito (Capwell's Dept. Store)	37.899 N 122.298 W	dissected alluvium < 25 m	2-story & penthouse	ground level roof
64	Fremont (Mission San Jose)	37.530 N 121.919 W	alluvium ∿ 60 m over sandstone	1-story building	ground level
191	Halls Valley (Grant Park)	37.338 N 121.744 W	alluvium < 50 m	inst.shltr. (Armco)	ground level
219	Hayward (Apeel Array 3E)	37.657 N 122.060 W	altered metavolcanic rock	inst.shltr. (Armco)	ground level
354	Hayward (CSUH Adm. Bldg.)	37.655 N 122.056 W	altered metavolcanic rock	13-story building	basement 1st, 2nd, 5th, roof
180	Lexington Dam	37.202 N 121.949 W	Franciscan Fm	earth dam	L. & R. crest
359	Oakland (Caldecott Tunnel)	37.858 N 122.215 W	sandstone	inst.shltr. (T-hut)	ground level
225	Oakland (Calrus Bldg.)	37.742 N 122.148 W	dissected alluvium < 15 m	3-story building	ground floor roof
348	Pleasant Hill (Citizens Savings)	37.946 N 122.060 W	alluvium ∿ 50 m over sandstone	3-story building	ground floor 3rd, roof

TABLE I (con't)

No.	Station name	Coordinates	Site Geology	Structure Type/size	Instrument Location(s)
263	Redwood City (Canada College)	37.45 N 122.27 W	Franciscan metavolcanic rock	3-story building	ground floor roof
355	San Jose (Great Western Savings)	37.381 N 121.883 W	alluvium > 1000 m	10-story & basement building	basement 2nd, 5th roof
356	San Jose (Town Park Towers)	37.381 N 121.888 W	alluvium > 1000 m	10-story building	ground floor 6th, roof
187	San Ramon (Eastman Kodak Building)	37.729 N 121.928 W	dissected alluvium ∿ 50 m over sandstone	1-story building	ground floor roof
134	San Ramon (Fire Station)	37.78 N 121.98 W	alluvium ∿ 15 m over sandstone	1-story building	ground level
235	Saratoga (West Valley Community College)	37.262 N 122.009 W	dissected alluvium ∿50 m	1-story building	ground floor roof
261	So. San Francisco (Kaiser Med. Bldg.)	37.660 N 122.439 W	∿4 m fill over sand over Fran. Fm.	4-story building	basement 1st, 2nd, roof
63	Tracy (Sewage Treatment Plant)	37.46 N 121.42 W	alluvium > 1000 m	1-story & basement building	tank slab 3 m below ground level
364	Walnut Creek (Fidelity Savings)	37.907 N 122.065 W	sandstone	10-story building	ground floor 3rd, 8th, roof

TABLE II

Alphabetical list of CDMG strong-motion accelerograph stations that were triggered and recorded the 26 January 1980 Livermore earthquake.

No.	Station name	Coordinates	Site Geology	Structure Type/size	Instrument Location(s)
70	Antioch	38.015 N 121.813 W	alluvium ∿ 75 m	1-story & basement building	basement
Temp.	Antioch (Contra Loma Regional Park)	37.972 N 121.829 W	alluvium < 10 m overlying early Cenozoic rocks	1-story building	ground level
183	Briones Dam	37.55 N 122.21 W	sandstone	earth dam	L. abutment L. & C. crest
188	El Cerrito (Capwell's Dept. Store)	37.899 N 122.298 W	dissected alluvium < 25 m	2-story & penthouse building	ground level roof
64	Fremont (Mission San Jose)	37.52 N 121.92 W	alluvium ∿ 60 m over sandstone	1-story building	ground level
219	Hayward (Apeel Array 3E)	37.657 N 122.060 W	altered metavolcanic rock	inst.shltr. (Armco)	ground level
354	Hayward (CSUH Adm. Bldg.)	37.85 N 121.78 W	alluvium metavolcanic rock	13-story building	basement 1st,2nd,5th roof
Temp.	Livermore (Fagundes Ranch)	37.753 N 121.772 W	alluvium < 40 m over sandstone	carport on slab	ground level
Temp.	Livermore (Morgan Territory Park)	37.819 N 121.795 W	sandstone	exposed slab	ground level
359	Oakland (Caldecott Tunnel)	37.858 N 122.215 W	sandstone	inst.shltr. (T-hut)	ground level
225	Oakland (Calrus Bldg.)	37.742 N 122.148 W	dissected alluvium < 15 m	3-story building	ground floor
224	Oakland (Title Insurance and Trust)	37.806 N 122.267 W	alluvium < 200 m	2-story & penthouse building	ground floor roof

TABLE II (con't)

No.	Station name	Coordinates	Site Geology	Structure Type/size	Instrument Location(s)
348	Pleasant Hill (Citizens Savings)	37.946 N 122.060 W	alluvium ∿ 50 m over sandstone	3-story building	ground floor 3rd, roof
263	Redwood City (Cañada College)	37.45 N 122.27 W	Franciscan metavolcanic rock	3-story building	ground floor roof
355	San Jose (Great Western Savings)	37.381 N 121.883 W	alluvium >1000 m	10-story & basement building	basement 2nd, 5th roof
356	San Jose (Town Park Towers)	37.381 N 121.888 W	alluvium > 1000 m	10-story building	ground level 6th, roof
187	San Ramon (Eastman Kodak Building)	37.729 N 121.928 W	dissected alluvium ∿ 50 m over sandstone	1-story building	ground floor roof
134	San Ramon (Fire Station)	37.78 N 121.98 W	alluvium ∿ 15 m over sandstone	1-story building	ground floor roof
235	Saratoga (West Valley Community College)	37.262 N 122.009 W	dissected alluvium ∿ 50 m	1-story building	ground floor roof
261	So. San Francisco (Kaiser Medical Building)	37.660 N 122.439 W	∿ 4 m fill over sand over Fran. Fm.	4-story building	basement 1st, 2nd roof
364	Walnut Creek (Fidelity Savings)	37.907 N 122.065 W	sandstone	10-story building	ground floor 3rd,8th,roof

GROUND MOTION DATA

TABLE III

Earthquake ground motion data list for CDMG accelerograph stations triggered by the 24 January 1980 Livermore earthquake. Stations are arranged in order of increasing epicentral distance.

No.	Station name	Coordinates	Epicentral[1] Distance (km)	S-T[2] Interval (sec)	WWVB[3] Trigger Time	Acceleration Aximuth[4]	Max (g)	Duration[5] >0.1 g (sec)	
187	San Ramon (Eastman Kodak Bldg)	37.729 N 121.928 W	16.7	3.7	n/a	145 Up 235	0.15 0.03 0.06	0.8	Digitized
134	San Ramon	37.78 N 121.98 W	17.2	2.2	n/a	70 Up 340	0.05 0.02 0.04	---	
70	Antioch	38.015 N 121.813 W	20.0	1.4	n/a	360 Up 270	0.01 0.03 0.04	---	
364	Walnut Creek (Fidelity Savings)	37.52 N 121.92 W	24.2	5.5	n/a	167 Up 77	0.03 0.02 0.03	---	
348	Pleasant Hill (Citizens Savings)	37.946 N 122.060 W	25.9	4.1	n/a	360 Up 90	0.03 0.01 0.03	---	
354	Hayward (CSUH Admin. Bldg)	37.85 N 121.78 W	30.3	*	n/a	35 Up 146	0.03 0.02 0.04	---	
219	Hayward (Apeel Array 3E)	37.657 N 122.060 W	30.4	4.4	n/a	236 Up 146	0.08 0.02 0.06	---	
225	Oakland (Calrus Bldg)	37.742 N 122.148 W	32.8	3.5	n/a	30 Up 120	0.02 0.01 0.02	---	

TABLE III (con't)

Earthquake ground motion data list for CDMG accelerograph stations triggered by the 24 January 1980 Livermore earthquake. Stations are arranged in order of increasing epicentral distance.

No.	Station name	Coordinates	Epicentral[1] Distance (km)	S-T[2] Interval (sec)	WWVB[3] Trigger Time	Acceleration Aximuth[4]	Max (g)	Duration[5] >0.1 g (sec)	
64	Fremont	37.530 N 121.919 W	36.0	4.8	n/a	80 Up 350	0.05 0.03 0.06	---	Thick trace, problem ~18sec
359	Oakland (Caldecott Tunnel)	37.86 N 121.22 W	37.0	*	n/a	180 Up 270	0.01 0.01 0.02	---	
183	Briones Dam	37.55 N 122.21 W	48.4	6.8	n/a	140 Up 50	0.04 0.03 0.03	---	
188	El Cerrito (Capwell's Dept Store)	37.899 N 122.298 W	44.5	5.0	n/a	337 Up 67	0.01 <0.01 <0.01	---	
356	San Jose (Town Park Towers)	37.381 N 121.888 W	51.7	2.4	n/a	150 Up 60	0.02 0.02 0.02	---	
355	San Jose (Great Western Savings)	37.381 N 121.883 W	51.5	*	n/a	330 Up 240	0.01 0.01 0.02	---	
63	Tracy— (Sewage Treatment Plant)	37.46 N 121.42 W	53.9	6.2	n/a	360 Up 270	0.09 0.04 0.05	---	Thick trace
191	Halls Valley (Grant Park)	37.338 N 121.744 W	55.7	*	00:29.1	240 Up 150	0.08 0.03 0.05	---	Late Trigger
261	South San Francisco (Kaiser Medical Bldg)	37.338 N 122.439 W	59.8	3.9	n/a	41 Up 131	0.02 0.01 0.02	---	

TABLE III (con't)

Earthquake ground motion data list for CDMG accelerograph stations triggered by the 24 January 1980 Livermore earthquake. Stations are arranged in order of increasing epicentral distance.

No.	Station name	Coordinates	Epicentral[1] Distance (km)	S-T[2] Interval (sec)	WWVB[3] Trigger Time	Acceleration Aximuth[4]	Max (g)	Duration[5] >0.1 g (sec)
263	Redwood City (Canada College)	37.45 N 122.27 W	60.0	1.3	n/a	217 Up 127	0.01 <0.01 0.01	---
235	Saratoga (West Valley Community College)	37.262 N 122.009 W	67.0	1.1	n/a	360 Up 270	0.01 0.01 0.01	---
180	Lexington Dam	37.202 N 121.949 W	72.3	0.5	n/a	270 Up 180	0.02 0.01 0.02	---
125	Capitola	36.974 N 121.952 W	97.5	*	n/a	132 Up 42	0.01 0.02 0.03	---

[1]Distance from epicenter at latitude 37.84 N and longitude 121.80 W (USGS).

[2]S-wave arrival minus trigger time.
*S-T is not recognizable

[3]Trigger time in minutes and seconds on Julian day 24, 19 hours (UTC) as determined from WWVB time code.

[4]Azimuthal direction of ground acceleration for upward trace deflection on accelerogram (degrees clockwise from north).

[5]Time between first and last peak of trace registering greater than 0.10 g acceleration.

STRONG MOTION RECORD DATA

STATION: Name San Ramon - Fire Station
Address 2241 San Ramon Valley Blvd.
San Ramon, California
County Contra Costa Elevation 152 m
CDMG 134 Latitude 37.78 °N
USGS 1383 Longitude 121.98 °W

INSTRUMENT: Type (Traces)	Serial Number	Date Installed	Date Removed
SMA-1 (3)	1685	6/10/74	8/27/76
SMA-1T (3)	2522	8/27/76	in place

EARTHQUAKE: Name (Region) Livermore
Date 24 Jan 80 (UTC) 1900 Epicentral Distance 17.2 km

SITE GEOLOGY: Station underlain by alluvium (~15 m) of San Ramon Valley which overlies Miocene marine Briones sandstone of San Pablo Group. San Ramon Valley defines trace of Calaveras fault zone.

TRACE EVALUATION

Trace (from top)	Orientation	Sensitivity (mm/g)	Nat Freq (Hz)	Damping (% crit)	Peak Accel (% g)
1	70	19.1	25.6	60	+4.2, -4.2
2	Up	17.0	26.2	56	+1.8, -1.2
3	340	17.3	26.2	59	+5.3 -4.3
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -

Structural orientation reference: North = n/a °

OSMS Rev 4/9/80

San Ramon-Fire Station
37.78 N-121.98°W
SMA-1T #2522 Ch 3
CDMG #134

Livermore EQ
24Jan80 1100 PST (1900 UTC)
37.84°N-121.80°W
Mag 5.9

Sensitivities mm/g
1 +18.67
-18.56
2 +17.01
-17.04
3 +16.96
-16.88

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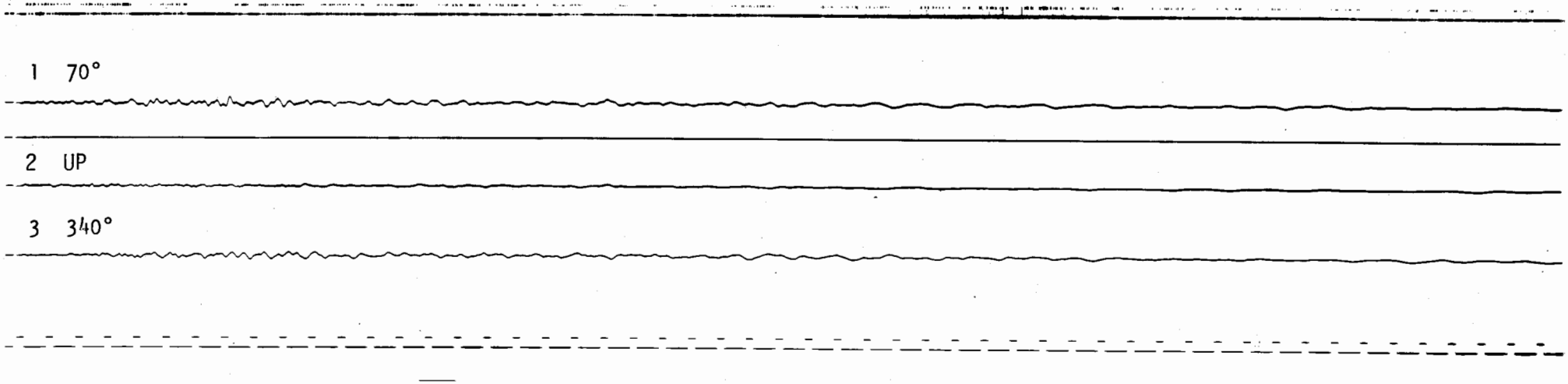


STRONG MOTION RECORD DATA

STATION: Name Hayward - Apeel 3E

Address Calif. State University, Hayward

Hayward, California

County Alameda Elevation 134 m

CDMG 219 Latitude 37.657 °N

USGS - Longitude 122.060 °W

INSTRUMENT: Type (Traces)	Serial Number	Date Installed	Date Removed
SMA-1T (3)	1809	11/11/75	in place

EARTHQUAKE: Name (Region) Livermore

Date 24 Jan 80 (UTC) 1900 Epicentral Distance 30.5 km

SITE GEOLOGY: Station underlain by altered and sheared metavolcanic rock as fault sliver within Hayward-Chabot fault zone. Great Valley rocks exposed in hills east of station and alluvium underlies San Francisco Bay region to west.

TRACE EVALUATION

Trace (from top)	Orientation	Sensitivity (mm/g)	Nat Freq (Hz)	Damping (% crit)	Peak Accel (% g)
1	236	18.3	25.8	63	+7.7, -5.2
2	Up	19.3	25.2	59	+2.3, -1.8
3	146	18.4	25.3	59	+6.0, -6.0
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -

Structural orientation reference: North = n/a °

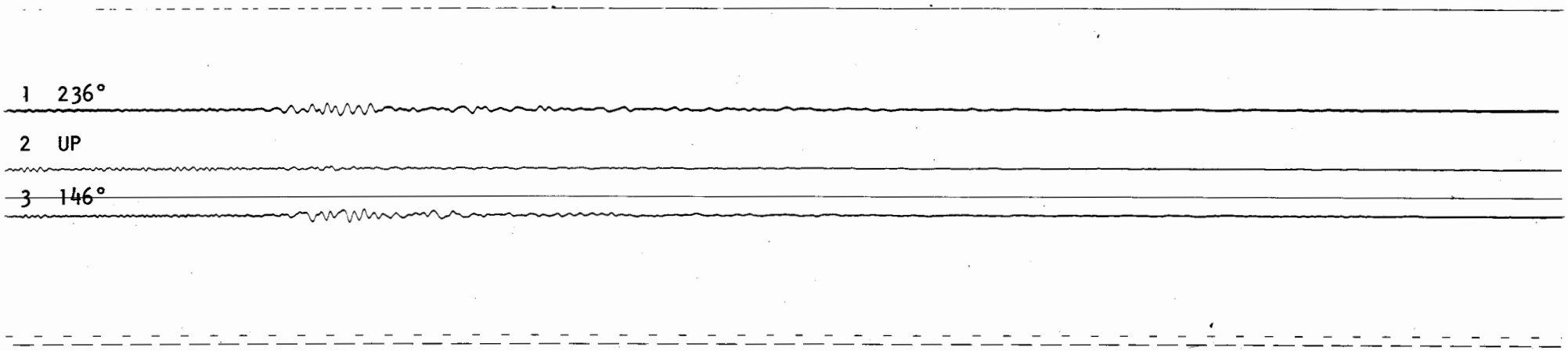
OSMS Rev 4/9/80

Hayward-Apeel Array 3E
37.657°N-122.060°W
SMA-1T #1809 Ch 3
CDMG #219

Livermore EQ
24Jan80 1100 PST (1900 UTC)
37.84°N-121.80°W
Mag 5.9

Sensitivities mm/g
1 18.3
2 19.3
3 18.4

Copy Scale (1 cm)
Film Speed = 2 time mark/sec



STRONG MOTION RECORD DATA

STATION: Name Fremont - Mission San Jose

Address 190 Anza

Fremont, California

County Alameda Elevation 93 m

CDMG 64 Latitude 37.530 °N

USGS 1299 Longitude 121.919 °W

INSTRUMENT: Type (Traces)	Serial Number	Date Installed	Date Removed
RFT-250 (3)	525	12/12/73	2/21/74
RFT-350 (3)	553	2/21/74	in place

EARTHQUAKE: Name (Region) Livermore

Date 24 Jan 80 (UTC) 1900 Epicentral Distance 36.0 km

SITE GEOLOGY: Station underlain by Quaternary alluvium (<15 m) overlying Pleistocene Santa Clara gravel (fanglomerate deposits ~15 m - ?) thick. Quaternary deposits overlie Miocene marine rocks between the Hayward and Mission faults.

TRACE EVALUATION

Trace (from top)	Orientation	Sensitivity (mm/g)	Nat Freq (Hz)	Damping (% crit)	Peak Accel (% g)	
1	75	17.6	21.8	62	+ 3.1	- 5.1
2	Up	17.9	22.0	61	+ 2.2	- 2.8
3	345	18.0	21.8	57	+ 5.4	- 6.3
					+	-
					+	-
					+	-
					+	-
					+	-
					+	-
					+	-
					+	-
					+	-

Structural orientation reference: North = n/a °

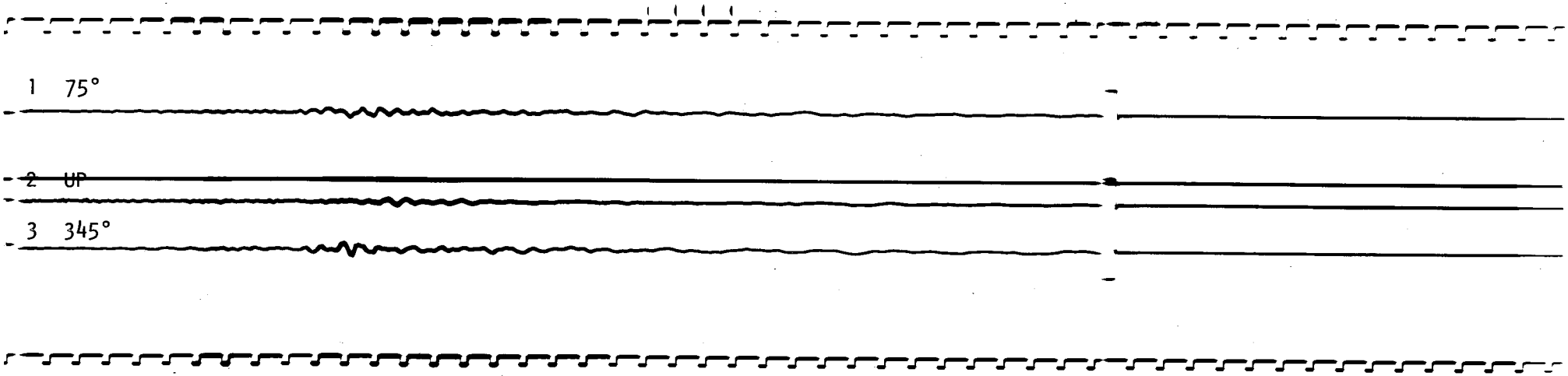
OSMS Rev 4/9/80

Fremont-Mission San Jose
37.530°N-121.919°W
RFT-350 #553 Ch 3
CDMG #64

Livermore EQ
24Jan80 1100 PST (1900 UTC)
37.84°N-121.80°W
Mag 5.9

Sensitivities mm/g
1 17.6
2 17.9
3 18.0

Copy Scale (1 cm)
Film Speed = 2 time mark/sec



STRONG MOTION RECORD DATA

STATION: Name Tracy - Sewage Treatment Plant

Address 3900 Holly Drive

Tracy, California

County San Joaquin Elevation 5 m

CDMG 63 Latitude 37.46 °N

USGS 1298 Longitude 121.42 °W

INSTRUMENT: Type (Traces)	Serial Number	Date Installed	Date Removed
RFT-250 (3)	555	2/21/74	in place

EARTHQUAKE: Name (Region) Livermore

Date 24 Jan 80 (UTC) 1900 Epicentral Distance 53.9 km

SITE GEOLOGY: Station underlain by dissected Pleistocene alluvial fan deposits of Riverbank Formation which overlie several thousand meters of older Quaternary deposits filling San Joaquin Valley.

TRACE EVALUATION

Trace (from top)	Orientation	Sensitivity (mm/g)	Nat Freq (Hz)	Damping (% crit)	Peak Accel (% g)
1	183	17.5	21.7	59	+9.4, -9.4
2	Up	17.9	21.5	59	+3.9, -1.4
3	93	18.3	21.8	59	+5.5, -2.2
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -

Structural orientation reference: North = n/a °

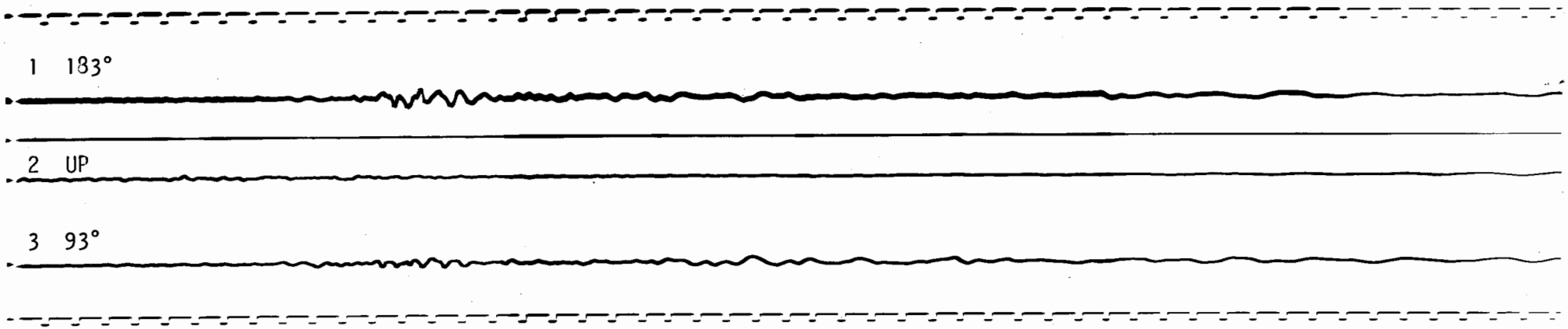
OSMS Rev 4/9/80

Tracy-Sewage Treatment Plant
37.46°N-121.42°W
RFT-250 #555 Ch 3
CDMG #63

Livermore EQ
24Jan80 1100 PST (1900 UTC)
37.84°N-121.80°W
Mag 5.9

Sensitivities mm/g
1 17.5
2 17.9
3 18.3

Copy Scale (1 cm)
Film Speed = 2 time mark/sec



STRONG MOTION RECORD DATA

STATION: Name Halls Valley - Grant Park

Address Highway 130

San Jose, California

County Santa Clara Elevation 465 m

CDMG 191 Latitude 37.338 °N

USGS 1422 Longitude 121.744 °W

INSTRUMENT: Type (Traces)	Serial Number	Date Installed	Date Removed
RFT 350 (3)	546	5/16/75	6/24/76
SMA-1T (3)	2496	6/24/76	in place

EARTHQUAKE: Name (Region) Livermore

Date 24 Jan 80 (UTC) 1900 Epicentral Distance 55.7 km

SITE GEOLOGY: Station underlain by Holocene alluvium (< 50m) of Halls Valley. Franciscan sandstone is exposed east of Halls Valley and Miocene Briones sandstone is exposed to west. Halls Valley defines trace of Calaveras fault zone.

TRACE EVALUATION

Trace (from top)	Orientation	Sensitivity (mm/g)	Nat Freq (Hz)	Damping (% crit)	Peak Accel (% g)
1	240	18.2	26.0	60	+7.8, -4.1
2	Up	17.8	26.8	57	+2.8, -1.7
3	150	17.2	26.8	57	+4.1 -5.5
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -

Structural orientation reference: North = n/a °

OSMS Rev 4/9/80

Halls Valley-Grant Pk
37.338°N-121.744°W
SMA-1T #2496 Ch 3
CDMG #191

Livermore EQ
24Jan80 1100 PST (1900 UTC)
37.84°N-121.80°W
Mag 5.9

Sensitivities mm/g
1 18.2
2 17.8
3 17.2

Copy Scale (1 cm)
Film Speed = 2 time mark/sec

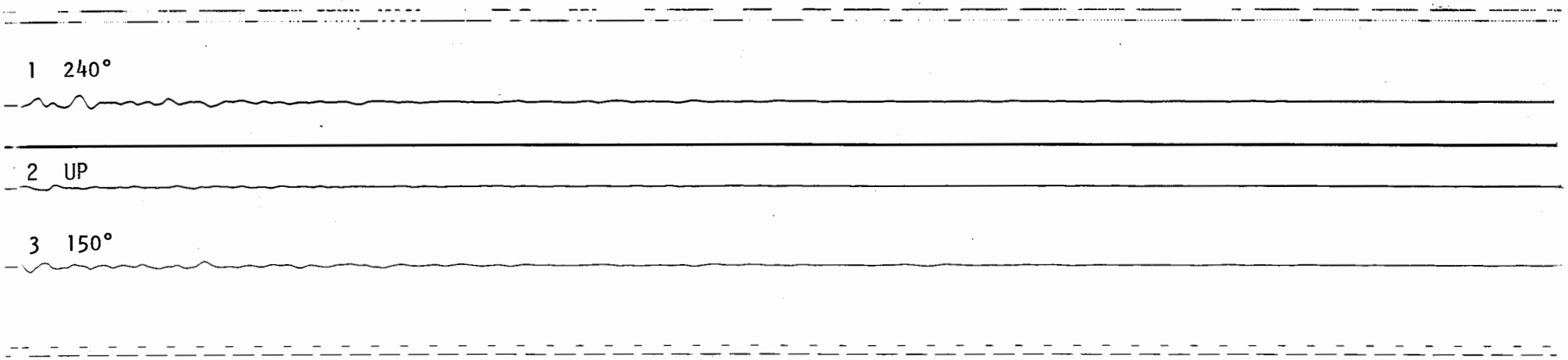


TABLE IV

Earthquake ground motion data list for CDMG accelerograph stations triggered by the 26 January 1980 Livermore earthquake. Stations are arranged in order of increasing epicentral distance.

No.	Station name	Coordinates	Epicentral[1] Distance (km)	S-T[2] Interval (sec)	WWVB[3] Trigger Time	Acceleration Aximuth[4]	Max (g)	Duration[5] >0.1 g (sec)
Temp.	Livermore (Fagundes Ranch)	37.75 N 121.77 W	6.3	1.9	33:38.5	360 Up 270	0.22 0.10 0.25	1.0
Temp.	Livermore (Morgan Territory Park)	37.82 N 121.45 W	11.0	2.6	33:39.2	355 Up 265	0.27 0.08 0.19	1.5
187	San Ramon (Eastman Kodak Bldg)	37.729 N 120.928 W	20.5	3.9	n/a	145 Up 235	0.28 0.04 0.09	0.65
134	San Ramon (Fire Station)	37.78 N 121.98 W	24.8	4.1	33:41.75	70 Up 340	0.04 0.02 0.05	---
Temp.	Antioch (Contra Loma Regional Park)	37.97 N 121.83 W	26.0	4.6	33:42.1	360 Up 270	0.04 0.01 0.03	---
70	Antioch	38.015 N 121.813 W	30.5	5.3	n/a	360 Up 270	0.05 0.02 0.11	---
64	Fremont (Mission San Jose)	37.52 N 121.92 W	32.1	4.3	n/a	80 Up 350	0.04 0.02 0.11	---

No P. Clue in Part 43

TABLE IV (con't)

Earthquake ground motion data list for CDMG accelerograph stations triggered by the 26 January 1980 Livermore earthquake. Stations are arranged in order of increasing epicentral distance.

No.	Station name	Coordinates	Epicentral[1] Distance (km)	S-T[2] Interval (sec)	WWVB[3] Trigger Time	Acceleration Aximuth[4]	Acceleration Max (g)	Duration[5] >0.1 g (sec)
364	Walnut Creek (Fidelity Savins)	37.91 N 122.06 W	35.8	5.4	n/a	77 Up 167	0.06 0.02 0.05	---
354	Hayward (CSUH Admin. Bldg.)	37.85 N 121.78 W	37.6	0.1	n/a	305 Up 35	0.06 0.02 0.03	---
219	Hayward (Apeel Array 3E)	37.657 N 122.060 W	37.7	4.6	33:42.8	236 Up 146	0.04 0.02 0.08	---
225	Oakland (Calrus Bldg.)	37.742 N 122.148 W	39.7	8.0	n/a	30 Up 120	0.02 0.01 0.02	---
348	Pleasant Hill (Citizens Savings)	37.946 N 122.060 W	38.1	5.3	n/a	360 Up 90	0.03 0.02 0.06	---
355	San Jose (Great Western Savings)	37.381 N 121.883 W	45.1	6.7	n/a	330 Up 240	<0.01 <0.01 0.01	---
356	San Jose (Town Park Towers)	37.381 N 121.888 W	45.4	*	n/a	150 Up 60	0.01 <0.01 0.01	---

TABLE IV (con't)

Earthquake ground motion data list for CDMG accelerograph stations triggered by the 26 January 1980 Livermore earthquake. Stations are arranged in order of increasing epicentral distance.

No.	Station name	Coordinates	Epicentral[1] Distance (km)	S-T[2] Interval (sec)	WWVB[3] Trigger Time	Acceleration Aximuth[4]	Max (g)	Duration[5] >0.1 g (sec)
359	Oakland (Caldecott Tunnel)	37.86 N 122.22 W	47.1	*	n/a	180 Up 270	0.01 0.01 0.02	---
183	Briones Dam (left abutment)	37.55 N 122.21 W	50.7	7.3	n/a	142 Up 52	0.03 0.01 0.04	---
188	El Cerrito (Capwell's Dept. Store)	37.899 N 122.298 W	55.1	7.5	n/a	337 Up 67	0.02 <0.01 <0.01	---
224	Oakland (Title Insurance Trust)	37.806 N 122.267 W	50.5	6.9	n/a	141 Up 231	0.03 0.02 <0.01	---
263	Redwood City (Canada College)	37.45 N 122.27 W	61.0	*	n/a	217 Up 127	<0.01 <0.01 <0.01	---

TABLE IV (con't)

Earthquake ground motion data list for CDMG accelerograph stations triggered by the 26 January 1980 Livermore earthquake. Stations are arranged in order of increasing epicentral distance.

No.	Station name	Coordinates	Epicentral[1] Distance (km)	S-T[2] Interval (sec)	WWVB[3] Trigger Time	Acceleration Aximuth[4]	Acceleration Max (g)	Duration[5] 0.1 g (sec)
235	Saratoga (W. Valley Comm. College)	37.262 N 122.009 W	61.9	1.1	n/a	360 Up 127	0.01 <0.01 0.01	---
261	South San Francisco (Kaiser Medical Bldg.)	37.660 N 122.439 W	66.2	1.5	n/a	41 Up 131	0.01 0.01 0.01	---

[1]Distance from epicenter at latitude 37.76 N and longitude 121.70 W.

[2]S-wave arrival minus trigger time.
*S-T is not recognizable.

[3]Trigger time in minutes and seconds on Julian day 26, 02 hours (UTC) as determined from WWVB time code.

[4]Azimuthal direction of ground acceleration for upward trace deflection on accelerogram (degree clockwise from north).

[5]Time between first and last peak of trace registering greater than 0.10 g acceleration.

STRONG MOTION RECORD DATA

STATION: Name Livermore - Fagundes Ranch

Address 2012 Manning Road

Livermore, California

County Alameda Elevation 194 m

CDMG (Temp.) Latitude 35.753 °N

USGS - Longitude 121.772 °W

INSTRUMENT: Type (Traces)	Serial Number	Date Installed	Date Removed
SMA-1	2524	1/25/80	in place

EARTHQUAKE: Name (Region) Livermore

Date 26 Jan 80 (UTC) 0233 Epicentral Distance 6.3 km

SITE GEOLOGY: Station underlain by alluvium (<40 m) of Livermore Valley that overlies Pliocene non-marine Orinda Formation.

TRACE EVALUATION

Trace (from top)	Orientation	Sensitivity (mm/g)	Nat Freq (Hz)	Damping (% crit)	Peak Accel (% g)
1	360	16.9	26.3	57	+21.7, -17.1
2	Up	18.9	25.8	57	+ 7.9, - 9.5
3	270	18.9	25.7	60	+25.4, -16.2
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -

Structural orientation reference: North = n/a °

OSMS Rev 4/9/80

Livermore-Fagundes Ranch
37.753°N-121.772°W
SMA-1T #2524 Ch 3
CDMG Temp Site

Livermore EQ
26Jan80 1833 PST (0233 UTC)
37.76°N-121.70°W
Mag 5.2

Sensitivities mm/g
1 16.9
2 18.9
3 18.9

Copy Scale (1 cm)
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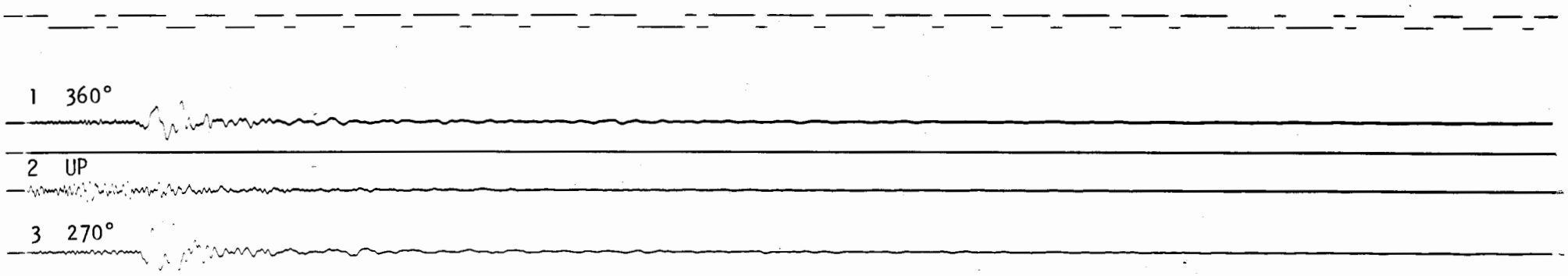

STRONG MOTION RECORD DATA

STATION: Name Livermore - Morgan Territory Park
Address 9604 Morgan Territory Road
Livermore, California
County Contra Costa Elevation 623 m
CDMG (Temp.) Latitude 37.819 °N
USGS - Longitude 121.795 °W

INSTRUMENT: Type (Traces)	Serial Number	Date Installed	Date Removed
SMA-1T	2589	1/24/80	in place

EARTHQUAKE: Name (Region) Livermore
Date 26 Jan 80 (UTC) 0233 Epicentral Distance 11.0 km

SITE GEOLOGY: Station underlain by Upper Cretaceous undifferentiated Great Valley sandstone and shale.

TRACE EVALUATION

Trace (from top)	Orientation	Sensitivity (mm/g)	Nat Freq (Hz)	Damping (% crit)	Peak Accel (% g)
1	355	18.0	25.7	59	+26.7, -27.2
2	Up	17.2	26.7	56	+ 7.8, - 6.7
3	265	19.0	25.6	59	+15.8, -18.9
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -

Structural orientation reference: North = n/a °

OSMS Rev 4/9/80

Livermore-Morgan Territory Park
37.819°N-121.795°W
SMA-1T #2589 Ch 3
CDMG-Temp Site

Livermore EQ
26Jan80 1833 PST (0233 UTC)
37.76°N-121.70°W
Mag 5.2

Sensitivities mm/g
1 18.0
2 17.2
3 19.0

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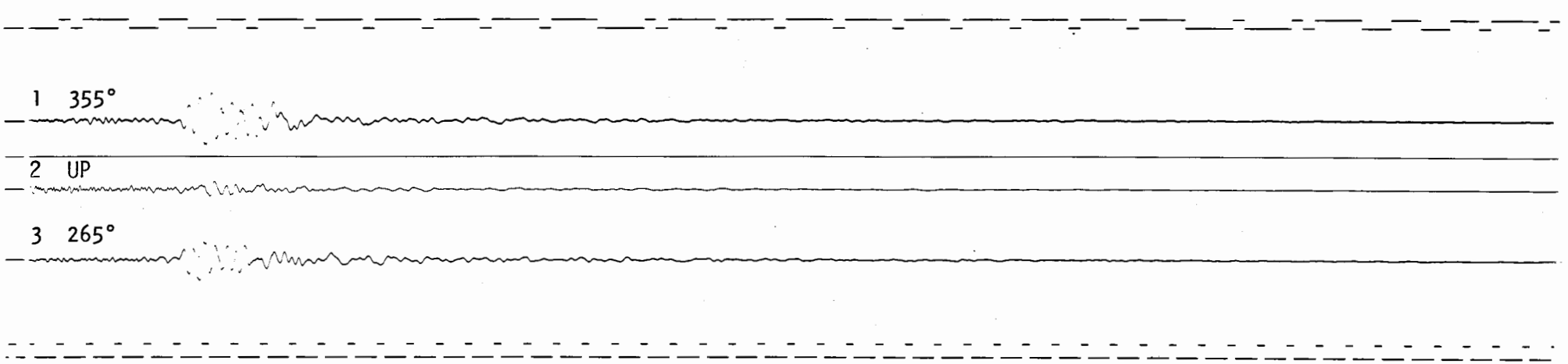
Film Speed = 2 time mark/sec



STRONG MOTION RECORD DATA

STATION: Name San Ramon - Fire Station

Address 2241 San Ramon Valley Blvd.

San Ramon, California

County Contra Costa Elevation 152 m

CDMG 134 Latitude 37.78 °N

USGS 1383 Longitude 121.98 °W

INSTRUMENT: Type (Traces)	Serial Number	Date Installed	Date Removed
SMA-1 (3)	1685	6/10/74	8/27/76
SMA-1T (3)	2522	8/27/76	in place

EARTHQUAKE: Name (Region) Livermore

Date 26 Jan 80 (UTC) 0233 Epicentral Distance 17.2 km

SITE GEOLOGY: Station underlain by alluvium (~15m) of San Ramon Valley which overlies Miocene marine Briones sandstone of San Pablo Group. San Ramon Valley defines trace of Calaveras fault zone.

TRACE EVALUATION

Trace (from top)	Orientation	Sensitivity (mm/g)	Nat Freq (Hz)	Damping (% crit)	Peak Accel (% g)
1	70	19.1	25.6	60	+4.2, -4.2
2	Up	17.0	26.2	56	+1.8, -1.2
3	340	17.3	26.2	59	+5.3, -4.3
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -

Structural orientation reference: North = n/a °

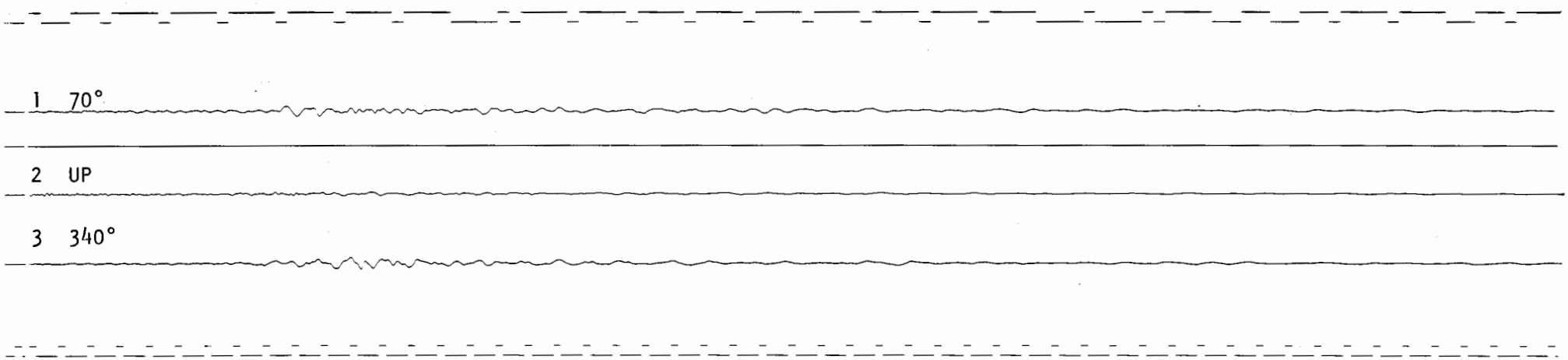
OSMS Rev 4/9/80

San Ramon-Fire Station
37.78° N-121.98° W
SMA-1T #2522 Ch 3
CDMG #134

Livermore EQ
26Jan80 1833 PST (0233 UTC)
37.76° N-121.70° W
Mag 5.2

Sensitivities mm/g
1 19.1
2 17.0
3 17.3

Copy Scale (1 cm)
Film Speed = 2 time mark/sec



STRONG MOTION RECORD DATA

STATION: Name Antioch

Address 510 G Street

Antioch, California

County Contra Costa Elevation 10 m

CDMG 70 Latitude 38.015 °N

USGS 1308 Longitude 121.813 °W

INSTRUMENT: Type (Traces)	Serial Number	Date Installed	Date Removed
SMA-1T (3)	1589	2/27/74	in place

EARTHQUAKE: Name (Region) Livermore

Date 26 Jan 80 (UTC) 0233 Epicentral Distance 30.5 km

SITE GEOLOGY: Holocene alluvium (∿75 m - ?) deposited by San Joaquin River that overlies older Pleistocene alluvium. Pleistocene alluvium overlies early to middle Cenozoic marine rocks and possibly Great Valley Sequence at depth.

TRACE EVALUATION

Trace (from top)	Orientation	Sensitivity (mm/g)	Nat Freq (Hz)	Damping (% crit)	Peak Accel (% g)
1	360	18.8	26.0	57	+2.7, - 4.8
2	Up	17.1	25.0	64	+1.5, - 1.8
3	270	17.8	26.0	60	+5.1, -11.0
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -

Structural orientation reference: North = n/a °

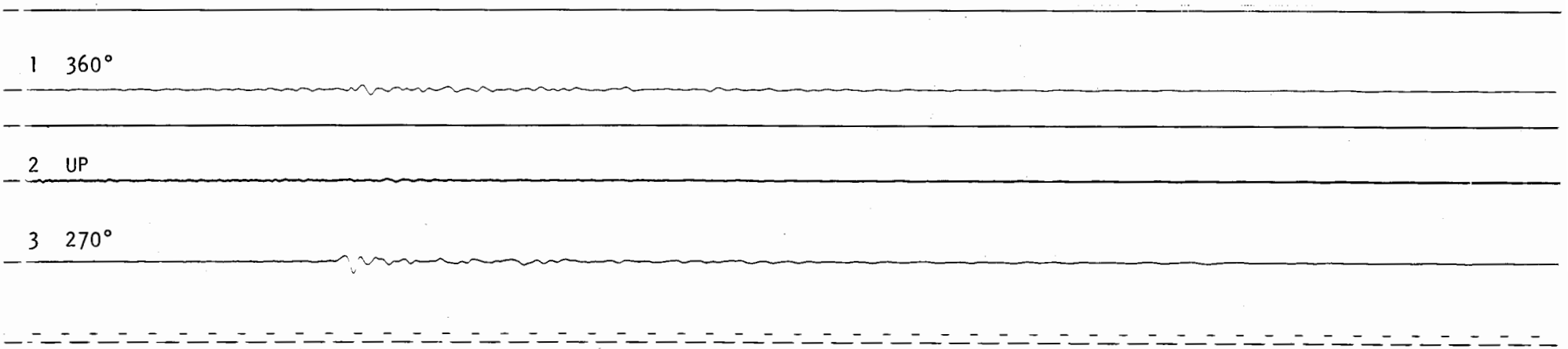
OSMS Rev 4/9/80

Antioch
38.015°N-121.813°W
SMA-1T #1589 Ch 3
CDMG #70

Livermore EQ
26Jan80 1833 PST (0233 UTC)
37.76°N-121.70°W
Mag 5.2

Sensitivities mm/g
1 18.8
2 17.1
3 17.8

Copy Scale (1 cm)
Film Speed = 2 time mark/sec



STRONG MOTION RECORD DATA

STATION: Name Hayward - Apeel Array #3E

Address Calif. State University, Hayward

Hayward, California

County Alameda Elevation 134 m

CDMG 219 Latitude 37.657 °N

USGS - Longitude 122.060 °W

INSTRUMENT: Type (Traces)	Serial Number	Date Installed	Date Removed
SMA-1T (3)	1809	11/11/75	in place

EARTHQUAKE: Name (Region) Livermore

Date 26 Jan 80 (UTC) 0233 Epicentral Distance 33.7 km

SITE GEOLOGY: Station underlain by altered and sheared metavolcanic rock as fault sliver within Hayward - Chabot fault zone. Great Valley rocks exposed in hills east of station and alluvium underlies San Francisco Bay region to west.

TRACE EVALUATION

Trace (from top)	Orientation	Sensitivity (mm/g)	Nat Freq (Hz)	Damping (% crit)	Peak Accel (% g)
1	236	18.3	25.8	63	+4.4, -2.8
2	Up	19.3	25.2	59	+1.6, -1.6
3	146	18.4	25.3	59	+7.6, -5.5
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -

Structural orientation reference: North = n/a °

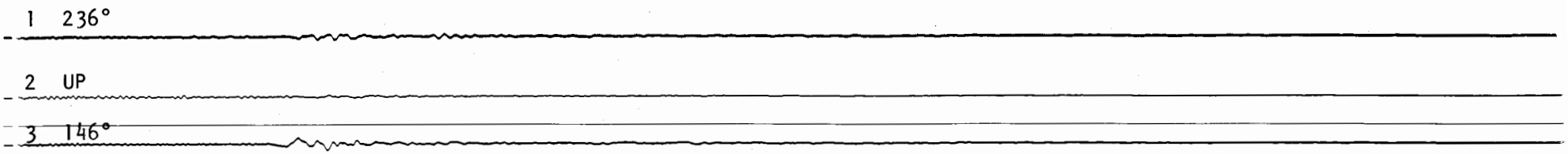
OSMS Rev 4/9/80

Hayward-Apeel Array 3E
37.657°N-122.060°W
SMA-1T #1809 Ch 3
CDMG #219

Livermore EQ
26Jan80 1833 PST (0233 UTC)
37.76°N-121.70°W
Mag 5.2

Sensitivities mm/g
1 18.3
2 19.3
3 18.4

Copy Scale (1 cm)
Film Speed = 2 time mark/sec



STRUCTURAL RESPONSE DATA

TABLE V

Structural response and station data for CDMG instrumented structures that recorded the 24 January 1980 Livermore earthquake. Stations are listed in alphabetical order.

No.	Station name	Coordinates	Structure Type/Size	Instrument Location(s)	Acceleration Max (g)	Loc.
183	Briones Dam	37.55 N 122.21 W	earthfill dam	L abutment L&C crest	0.03 0.04 0.03	L abut L crest C crest
188	El Cerrito (Capwell's)	37.899 N 122.298 W	2-story & penthouse building	ground level,roof	0.01 0.02	grnd roof
354	Hayward (CSUH Adm Bldg)	37.655 N 122.056 W	13-story building	basement 1st,2nd,5th roof	0.04 0.15	grnd roof
180	Lexington Dam	37.202 N 121.949 W	earthfill dam	L crest R crest	0.01 0.02	L crest R crest
225	Oakland (Calrus Bldg)	37.742 N 122.148 W	3-story building	ground floor roof	0.02 0.07	grnd roof
348	Pleasant Hill (Citizens Savings)	37.946 N 122.060 W	3-story building	ground floor 3rd,roof	0.03 0.10	grnd roof
263	Redwood City (Cãnada College)	37.45 N 122.27 W	3-story building	ground floor roof	0.01 0.02	grnd roof
355	San Jose (Grest Western Savings)	37.381 N 121.883 W	10-story & 1 basement bldg	basement 2nd,5th roof	0.02 0.05	grnd roof
356	San Jose (Town Park Towers)	37.381 N 121.888 W	10-story building	ground floor 6th,roof	0.02 0.07	grnd roof
187	San Ramon (Eastman Kodak Building)	37.729 N 121.928 W	1-story building	ground floor roof	0.15 0.24	grnd roof
235	Saratoga (West Valley Community College)	37.262 N 122.009 W	1-story building	ground floor roof	<0.01 0.07	grnd roof
261	So. San Francisco (Kaiser Medical Building)	37.660 N 122.439 W	4-story building	basement 1st,2nd roof	0.02 0.13	grnd roof
364	Walnut Creek (Fidelity Savings)	37.907 N 122.065 W	10-story building	ground floor 3rd,8th roof	0.03 0.17	grnd roof

INSTRUMENTED BUILDING DESCRIPTION FORM

Building: (Name and address) Administration Building
California State University Hayward
Hayward, CA

Coordinates: 37.655 °N 122.056 °W

Number of stories above/below ground: 13 / 0

Plan shape: Rectangular

Base dimensions: 122' x 125'

Typical floor plan dimensions: 110' x 113'

Vertical load carrying system: (include floor decking system) Metal deck floor slabs with 2 1/2" light-weight rc fill; steel beams and columns with nominal moment connections except for interior core moment frame.

Lateral force resisting system: (include element locations) Interior core moment steel frame and exterior perimeter rc moment frame; rc shear walls around elevator to 2nd floor.

Foundation type: Bearing piles with rc pile caps and 18" rc slab on grade.

Unusual architectural features: 2-story connecting bridge to adjacent library, high open story between 3rd and 4th floors.

Design date: 1969 Construction date: 1969-1971

Design engineer: (Name and address) Office of Architecture and Construction
Department of General Services
State of California, Sacramento, CA

Architect: (Name and address) Office of Architecture and Construction
Department of General Services
State of California
Sacramento, CA

Owner's Representative: (Name and address) c/o Don Farley
Chief of Plant Operations
California State University
Hayward, CA (415) 881-3799

Remarks: Building within 1 mile of Hayward fault.

STRONG MOTION RECORD DATA

STATION: Name Hayward CSUH Administration Building
Address Calif. State University, Hayward
Hayward, California
County Alameda Elevation 142 m
CDMG 354 Latitude 37.655 °N
USGS - Longitude 122.056 °W

INSTRUMENT: Type (Traces)	Serial Number	Date Installed	Date Removed
CR-1 (13)	188	3/16/79	in place

EARTHQUAKE: Name (Region) Livermore
Date 24 Jan 80 (UTC) 1900 Epicentral Distance 30.4 km

SITE GEOLOGY: Station underlain by altered and sheared metavolcanic rock as fault sliver within Hayward-Chabot fault zone. Great Valley rocks exposed in hills east of station and alluvium underlies San Francisco Bay region to west.

TRACE EVALUATION

Trace (from top)	Orientation	Sensitivity (mm/g)	Nat Freq (Hz)	Damping (% crit)	Peak Accel (% g)
1	N	+17.4 -17.0	52.6	63	+ 4.3, - 3.8
2	N	+17.6 -17.4	50.1	63	+14.8, -10.6
3	N	+17.4 -17.3	51.1	64	+12.4, -10.7
4	E	+17.3 -17.1	51.4	64	+ 6.9, - 8.2
5	N	+17.6 -17.6	50.4	63	+ 8.2, - 7.1
6	E	+17.4 -17.3	50.6	65	+ 2.3, - 4.3
7	N	+17.2 -17.3	53.0	64	+ 2.1, - 0.8
8	N	+17.8 -17.8	50.3	62	+ 7.9, - 6.2
9	E	+17.2 -17.0	53.7	67	+ 3.5, - 5.0
10	N	+17.4 -17.8	51.6	65	+ 6.9, - 5.1
11	N	+17.3 -17.3	50.9	64	+ 4.0, - 4.0
12	E	+16.8 -17.4	50.7	66	+ 3.6, - 4.6
13	N	+17.1 -17.6	52.7	67	+ 4.0, - 3.5

Structural orientation reference: North = 305 °

OSMS Rev 4/9/80

STRONG MOTION RECORD DATA

STATION: Name Hayward CSUH Administration Building

Address California State University Hayward

Hayward, California

County Alameda Elevation 142 m

CDMG 354 Latitude 37.655 °N

USGS - Longitude 122.056 °W

INSTRUMENT: Type (Traces)	Serial Number	Date Installed	Date Removed
SMA-1 (3)	3486	3/16/79	3/28/79
SMA-1 (3)	3489	3/28/79	in place

EARTHQUAKE: Name (Region) Livermore

Date 24 Jan 80 (UTC) 1900 Epicentral Distance 30.4 km

SITE GEOLOGY: Station underlain by altered and sheared metavolcanic rock as fault sliver within Hayward-Chabot fault zone. Great Valley rocks exposed in hills east of station and alluvium underlies San Francisco Bay region to west.

TRACE EVALUATION

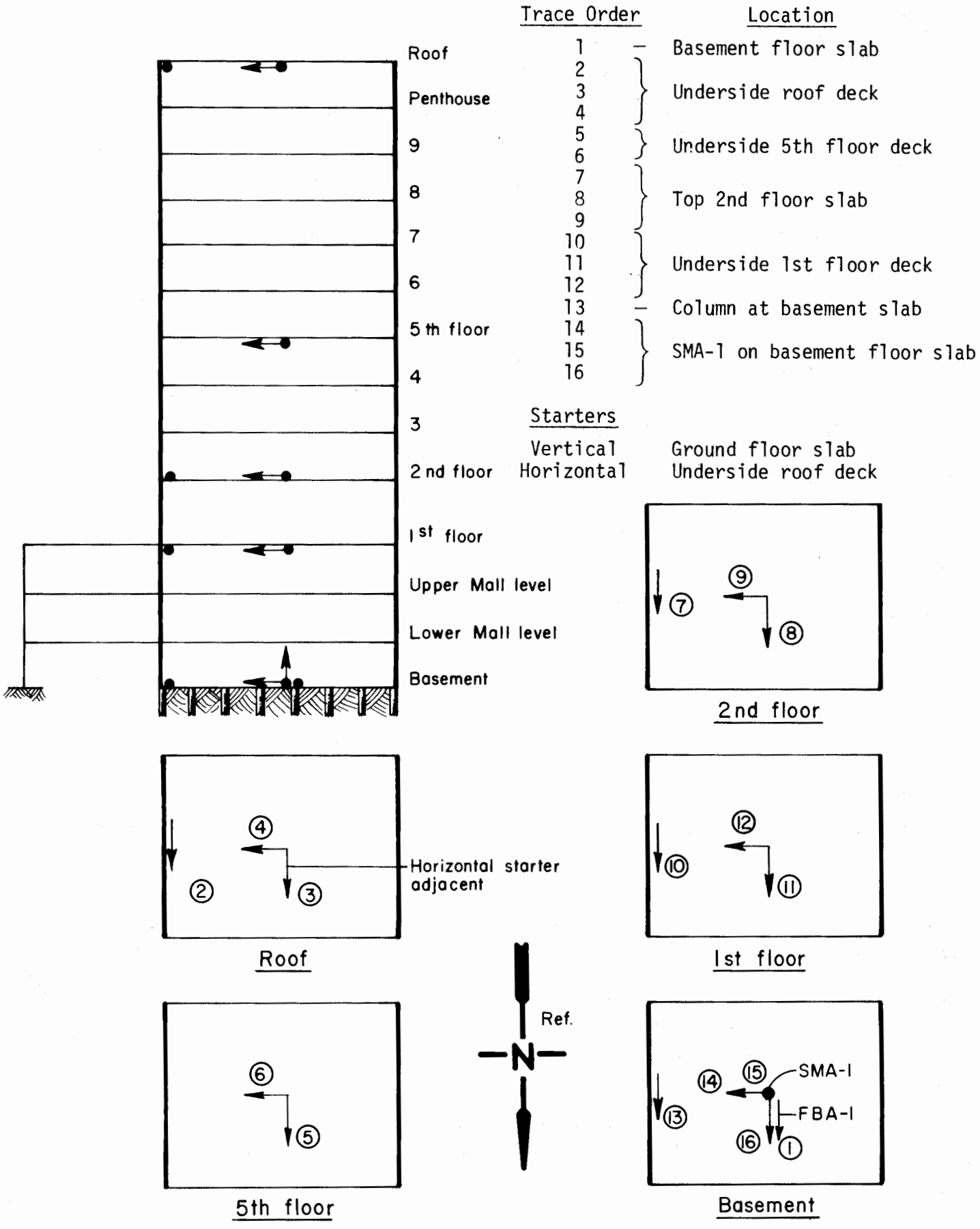
Trace (from top)	Orientation	Sensitivity (mm/g)	Nat Freq (Hz)	Damping (% crit)	Peak Accel (% g)	
14	E	18.7	25.1	56	+3.2	-1.6
15	Up	19.5	25.2	60	+1.5	-1.0
16	N	18.6	25.7	59	+4.3	-3.8
					+	-
					+	-
					+	-
					+	-
					+	-
					+	-
					+	-
					+	-
					+	-
					+	-

Structural orientation reference: North = 305 °

OSMS Rev 4/9/80

HAYWARD-CSUH ADMINISTRATION BUILDING

Strong-Motion Instrumentation Scheme



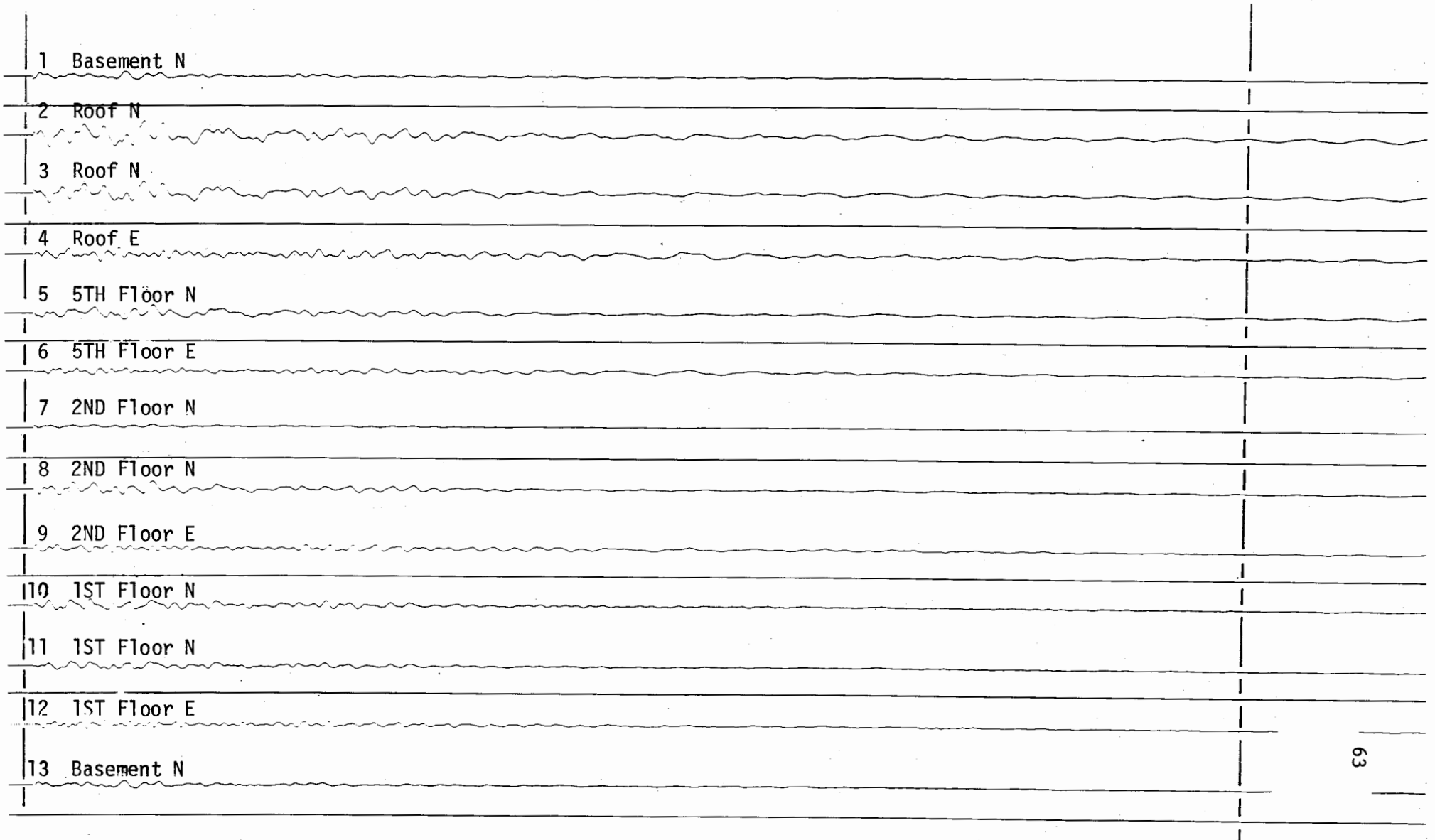
Hayward-CSUH Adm Bldg
37.655°N-122.056°W
CR-1 #188 Ch 13 (16)
CDMG #354

Livermore EQ
24Jan80 1100 PST (1900 UTC)
37.84°N-121.80°W
Mag 5.9

Sensitivities mm/g

1	+17.4	4	+17.3	7	+17.2	10	+17.4	13	+17.1		
	-17.0		-17.1		-17.3		-17.8		-17.6		
2	+17.6	5	+17.6	8	+17.8	11	+17.3				
	-17.4		-17.6		-17.8		-17.3				
3	+17.4	6	+17.4	9	+17.2	12	+16.8				
	-17.3		-17.3		-17.0		-17.4				

Copy Scale (1 cm)
Film Speed = 2 time mark/sec



Hayward-CSUH Adm Bldg
37.655°N-122.056°W
SMA-1 #3489 Ch 3 (16)
CDMG #354

Livermore EQ
24Jan80 1100 PST (1900 UTC)
37.84°N-121.80°W
Mag 5.9

Sensitivities mm/g
14 18.7
15 19.5
16 18.6

Copy Scale (1 cm)
Film Speed = 2 time mark/sec

Camera stall

Camera stall

14 Basement E

15 Basement UP

16 Basement N

INSTRUMENTED BUILDING DESCRIPTION FORM

Building: (Name and address) Citizens Savings and Loan
2255 Contra Costa Blvd.
Pleasant Hill, CA

Coordinates: 37.946 °N 122,060 °W

Number of stories above/below ground: 3 / 0

Plan shape: Rectangular

Base dimensions: 77' -0" x 131'-0"

Typical floor plan dimensions: same as base

Vertical load carrying system: (include floor decking system) Plywood sheathing, wood joists, glu-lam beams, steel columns and concrete columns and walls

Lateral force resisting system: (include element locations) Plywood diaphragms, concrete shear walls at first and second stories, cantilever concrete columns at third story

Foundation type: Spread footings

Unusual architectural features:

Design date: 1972 Construction date: 1973

Design engineer: (Name and address) Jordan Casper and Woodman
384 - 1st St.
Oakland, CA

Architect: (Name and address) Prata and Sylvester
3508G Mt. Diablo Blvd.
Lafayette, CA

Owner's Representative: (Name and address) Tom Numainville (Mardi Harding)
Bedford Associates
41 Lafayette Circle
Lafayette, CA

Remarks:

STRONG MOTION RECORD DATA

STATION: Name Pleasant Hill - Citizens Savings
Address 2255 Contra Costa Blvd.
Pleasant Hill, California
County Contra Costa Elevation 16 m
CDMG 348 Latitude 37.946 °N
USGS - Longitude 122.060 °W

INSTRUMENT: Type (Traces)	Serial Number	Date Installed	Date Removed
CR-1 (12)	179	1/16/79	in place

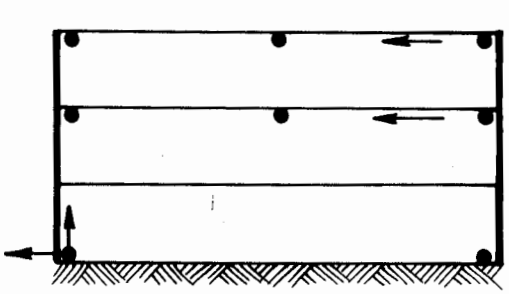
EARTHQUAKE: Name (Region) Livermore
Date 24 Jan 80 (UTC) 1900 Epicentral Distance 26.0 km

SITE GEOLOGY: Station underlian by Quaternary valley alluvium (∿50m-?) deposited by Walnut Creek. The alluvium overlies at depth early to middle Cenozoic marine rocks of several formations.

TRACE EVALUATION

Trace (from top)	Orientation	Sensitivity (mm/g)	Nat Freq (Hz)	Damping (% crit)	Peak Accel (% g)
1	Up	+18.3 -18.0	51.9	66	+0.5, -1.1
2	N	+17.9 -17.6	52.5	65	+5.0, -5.7
3	E	+17.8 -18.1	53.4	65	+3.4, -5.0
4	E	+18.1 -17.9	53.3	65	+9.9, -8.9
5	E	+18.3 -18.0	52.0	64	+5.2, -4.4
6	N	+18.1 -18.2	52.1	64	+3.4, -3.8
7	E	+17.4 -17.5	52.8	64	+2.9, -3.4
8	E	+17.2 -17.3	51.5	62	+7.0, -6.9
9	E	+17.3 -17.8	52.1	67	+1.7, -3.9
10	E	+17.2 -17.3	51.9	64	+2.6, -2.6
11	E	+17.1 -17.9	51.9	63	+2.6, -2.8
12	N	+17.6 -18.0	52.6	65	+2.8, -1.7
					+ -

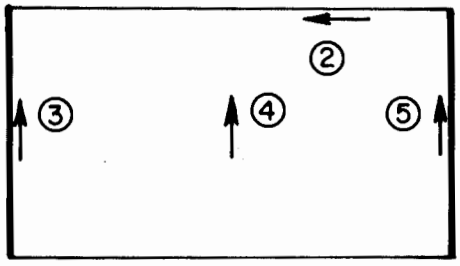
Structural orientation reference: North = 360 °



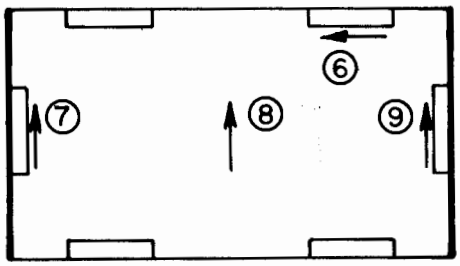
Elevation

PLEASANT HILL-CITIZENS SAVINGS

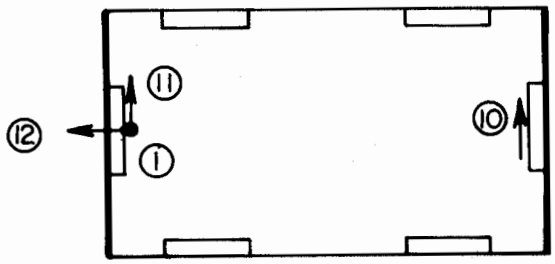
Strong-Motion Instrumentation Scheme



Roof



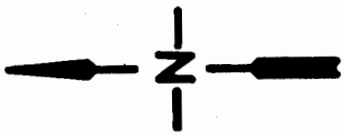
3rd floor



Ground

Trace Order		Location
1	-	Wall at ground floor
2	}	Wall at roof
3		
4	-	Glu-lam at roof
5	-	Wall at roof
6	}	Wall at 3rd floor
7		
8	-	Glu-lam at 3rd floor
9	-	Wall at 3rd floor
10	}	Wall at ground floor
11		
12		

Starters	
Vertical	Ground floor slab
Horizontal	Roof deck



Pleasant Hill-Citizens Savings
37.946°N-122.060°W
CR-1 #179 Ch 12
CDMG #348

Livermore EQ
24Jan80 1100 PST (1900 UTC)
37.84°N-121.80°W
Mag 5.9

Senitivities mm/g

1	+18.3	4	+18.1	7	+17.4	10	+17.2
	-18.0		-17.9		-17.5		-17.3
2	+17.9	5	+18.3	8	+17.2	11	+17.1
	-17.6		-18.0		-17.3		-17.9
3	+17.8	6	+18.1	9	+17.3	12	+17.6
	-18.1		-18.2		-17.8		-18.0

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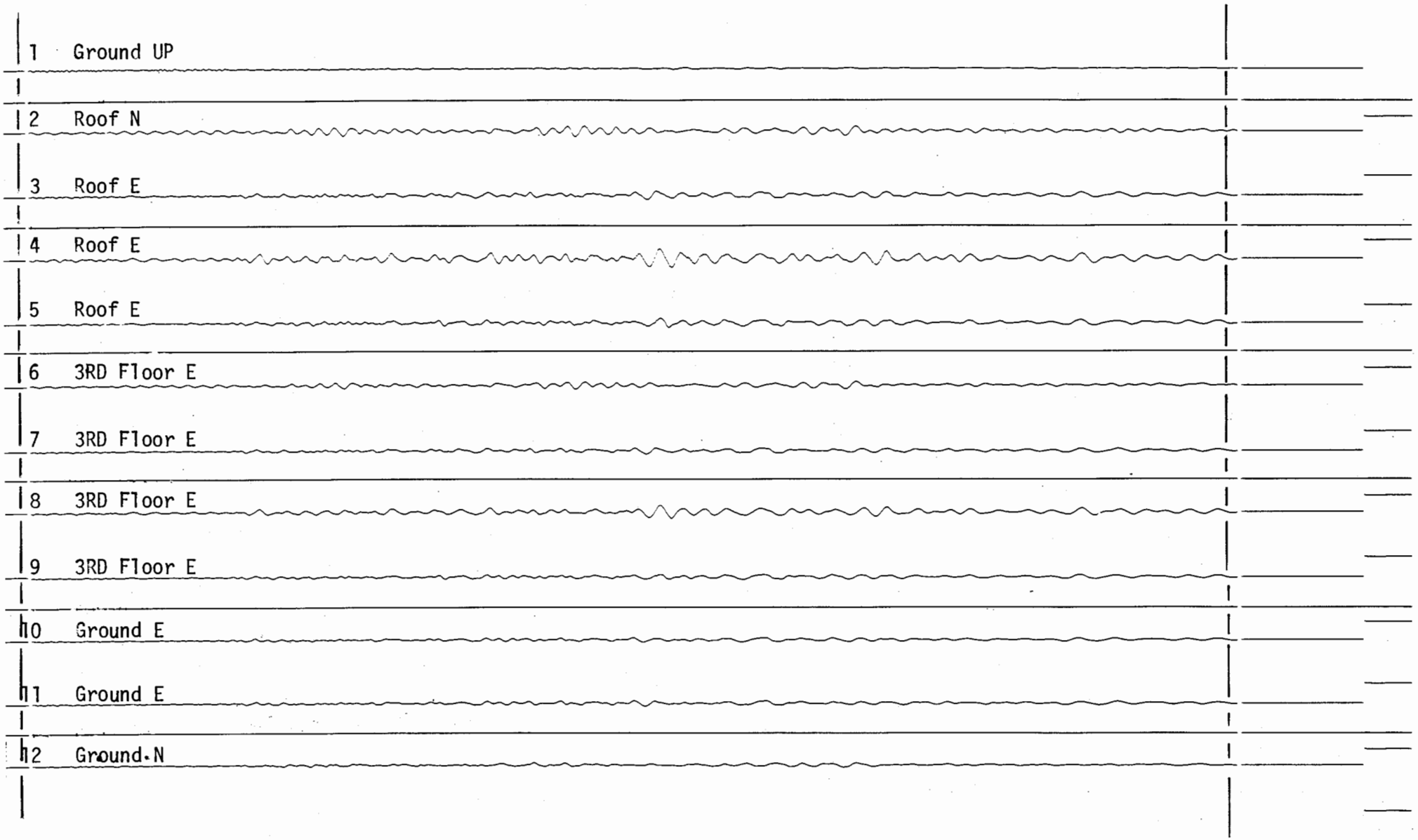
Film Speed =
2 time mark/sec



INSTRUMENTED BUILDING DESCRIPTION FORM

Building: (Name and address) Eastman Kodak Co. Distribution Center
1900 Alcosta Blvd.
San Ramon, CA

Coordinates: 37.74 °N 121.93 °W

Number of stories above/below ground: 1 / 0

Plan shape: Rectangular

Base dimensions: 384'0" x 360'0"

Typical floor plan dimensions: Same as base dimensions

Vertical load carrying system: (include floor decking system) Long span metal deck (7 1/2" depth) on steel truss; truss supported by WF steel columns throughout

Lateral force resisting system: (include element locations) Metal diaphragm and precast concrete shear walls

Foundation type: 6" r.c. slab, caissons

Unusual architectural features: None

Design date: 1968 Construction date: 1969

Design engineer: (Name and address) H.J. Brunnier Assoc.
55 New Montgomery
San Francisco, CA (415) 781-0370

Architect: (Name and address) Kitchen & Hunt, A.I.A.
20 Hawthorne St.
San Francisco, CA

Owner's Representative: (Name and address) Eastman Kodak Co.
Pacific Northern Region
1900 Alcosta Blvd.
San Ramon, CA

Remarks: Warehouse with pre-cast concrete panel exterior walls; one-story office building adjacent.

STRONG MOTION RECORD DATA

STATION: Name San Ramon - Eastman Kodak Building

Address 1900 Alcosta Blvd.

San Ramon, California

County Contra Costa Elevation 107 m

CDMG 187 Latitude 37.729 °N

USGS - Longitude 121.928 °W

INSTRUMENT: Type (Traces)	Serial Number	Date Installed	Date Removed
CR-1 (6)	105	2/25/75	3/28/80
CR-1 (9)	131	3/28/80	in place

EARTHQUAKE: Name (Region) Livermore

Date 24 Jan 80 (UTC) 1900 Epicentral Distance 16.7 km

SITE GEOLOGY: Station underlain by dissected Quaternary alluvium (~50m-?) of San Ramon Valley. Pliocene non-marine Orinda Formation underlies alluvium at depth. San Ramon Valley defines trace of Calaveras fault zone.

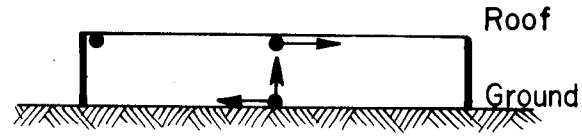
TRACE EVALUATION

Trace (from top)	Orientation	Sensitivity (mm/g)	Nat Freq (Hz)	Damping (% crit)	Peak Accel (% g)
1	N	19.4	51.8	66	+ 24.2, -21.1
2	N	19.2	50.6	67	+ 24.2, -20.6
3	E	18.9	51.2	66	+ 10.6, -15.9
4	S	18.2	53.5	66	+ 8.8, -14.8
5	Up	19.1	53.9	67	+ 3.1, - 3.1
6	W	19.1	52.5	64	+ 6.3, - 5.5
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -

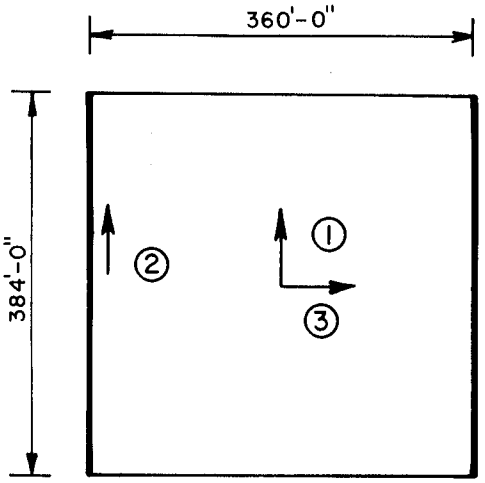
Structural orientation reference: North = 325 °

SAN RAMON-EASTMAN KODAK BUILDING

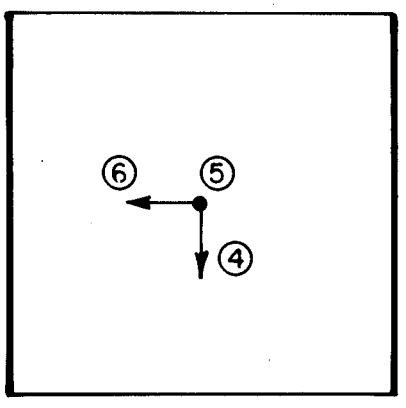
Strong-Motion Instrumentation Scheme



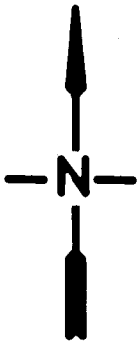
W-E Section



Roof Plan



Ground Floor Plan



Trace Order	Location
1, 2, 3	Roof truss
4, 5, 6	Ground floor slab

Starter	
Vertical	Ground floor slab

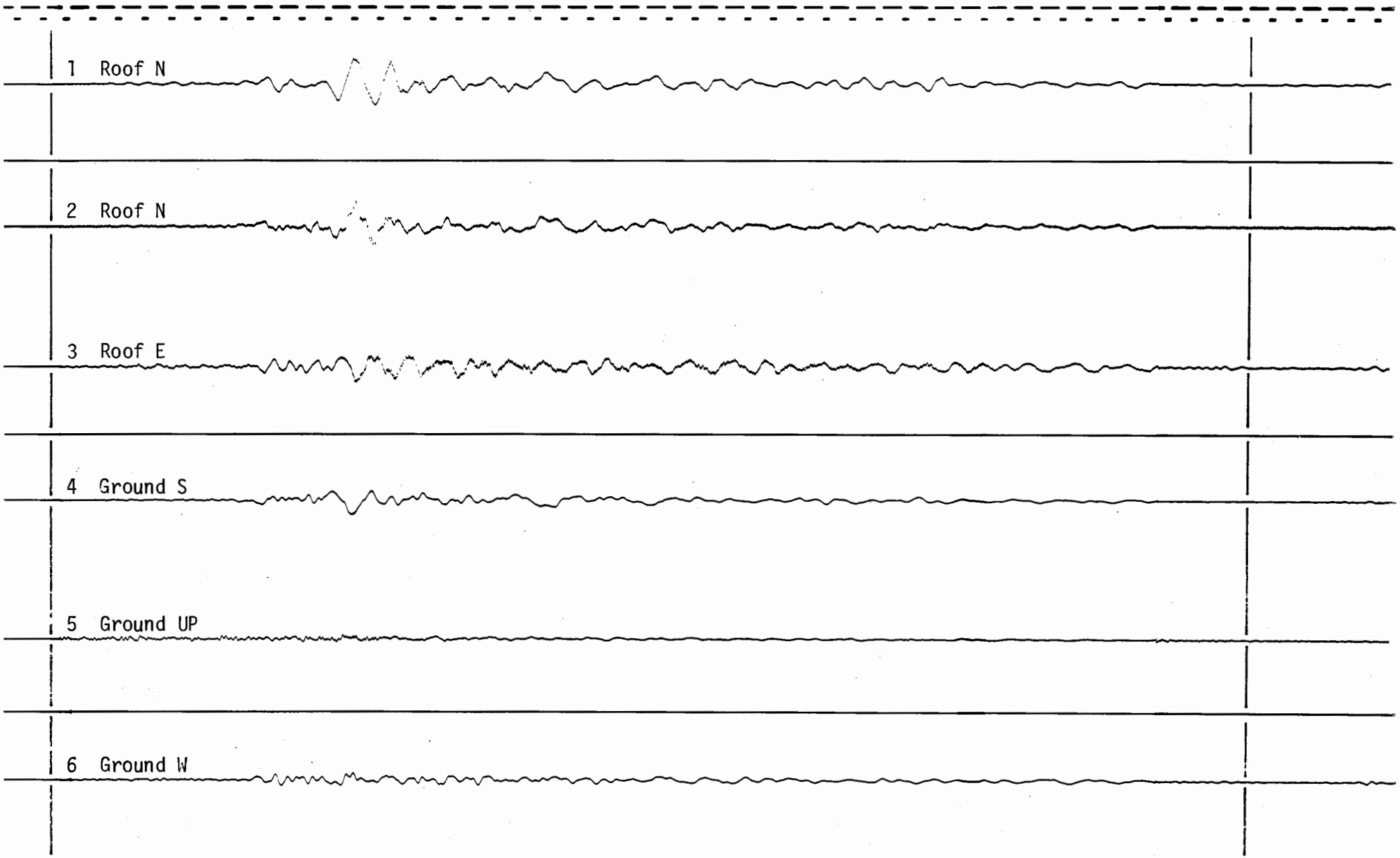
San Ramon-Eastman Kodak Bldg
37.729°N-121.928°W
CR-1 #105 Ch 6
CDMG #187

Livermore EQ
24Jan80 1100 PST (1900 UTC)
37.84°N-121.80°W
Mag 5.9

Sensitivities mm/g

1	19.4	4	18.2
2	19.2	5	19.1
3	18.9	6	19.1

Copy Scale (1 cm)
Film Speed = 2 time mark/sec



INSTRUMENTED BUILDING DESCRIPTION FORM

Building: (Name and address)
Fidelity Savings and Loan
1990 N. California Blvd.
Walnut Creek, CA

Coordinates: 37.907 °N 122.065 °W

Number of stories above/below ground: 10 / 0

Plan shape: Rectangular w/appendage at first floor only

Base dimensions: 104'-2" x 148'-2" (56'-1" x 58'-2" appendage)

Typical floor plan dimensions: 104'-2" x 148'-2"

Vertical load carrying system: (include floor decking system)
2-3/4" light weight concrete topping on 2-3/4" precast panel slab, precast prestressed concrete beams, concrete columns

Lateral force resisting system: (include element locations)
Interior core concrete shear wall and exterior precast and cast in place concrete frame.

Foundation type: Spread footings and caissons

Unusual architectural features:

Design date: 1970 Construction date: 1971

Design engineer: (Name and address)
T. Y. Lin, Kulka, Yang and Associate
15 Vandewater St.
San Francisco, CA

Architect: (Name and address)
Jorge De Quesada
2112 Divisadero St.
San Francisco, CA

Owner's Representative: (Name and address)
Daon Corp. (Peggy Roth)
1990 N. California Blvd.
Walnut Creek, CA

Remarks:

STRONG MOTION RECORD DATA

STATION: Name Walnut Creek - Fidelity Savings
Address 1990 N. California Blvd.
Walnut Creek, California
County Contra Costa Elevation 52 m
CDMG 37.907 Latitude 37.907 °N
USGS - Longitude 122.065 °W

INSTRUMENT: Type (Traces)	Serial Number	Date Installed	Date Removed
CR-1 (13)	194	12/14/79	in place

EARTHQUAKE: Name (Region) Livermore
Date 24 Jan 80 (UTC) 1900 Epicentral Distance 24.1 km

SITE GEOLOGY: Station underlain by Miocene marine sandstone and shale of San Pablo Group at northern closure of south-plunging east-dipping overturned syncline. Pliocene tuff (Lawlor tuff-?) exposed locally between San Pablo rocks and overlying Orinda Formation.

TRACE EVALUATION

Trace (from top)	Orientation	Sensitivity (mm/g)	Nat Freq (Hz)	Damping (% crit)	Peak Accel (% g)
1	E	+18.0 -17.5	52.3	64	+ 2.8, - 2.9
2	E	+18.3 -18.2	51.8	64	+17.8, -13.7
3	E	+18.2 -17.8	51.1	64	+10.7, - 8.4
4	E	+18.2 -17.8	50.4	63	+13.7, -11.8
5	S	+17.8 -17.7	52.2	65	+ 9.6, -11.6
6	E	+17.8 -17.8	51.3	64	+12.4, -11.5
7	E	+18.0 -17.6	51.8	63	+ 4.4, - 7.4
8	S	+17.7 -17.6	50.7	63	+ 8.5, - 7.4
9	E	+17.5 -17.6	51.2	64	+ 3.1, - 5.4
10	E	+17.6 -17.9	51.6	67	+ 4.0, - 3.6
11	S	+17.7 -17.8	50.8	62	+ 3.4, - 2.9
12	Up	+17.1 -17.4	51.7	64	+ 2.3, - 2.0
13	Up	+17.7 -17.6	52.9	63	+ 2.0, - 2.3

Structural orientation reference: North = 347 °

STRONG MOTION RECORD DATA

STATION: Name Walnut Creek - Fidelity Savings
Address 1990 N. California Blvd.
Walnut Creek, California
County Contra Costa Elevation 52 m
CDMG 364 Latitude 37.907 °N
USGS - Longitude 122.065 °W

INSTRUMENT: Type (Traces)	Serial Number	Date Installed	Date Removed
SMA-1 (3)	3490	12/14/79	in place

EARTHQUAKE: Name (Region) Livermore
Date 24 Jan 80 (UTC) 1900 Epicentral Distance 24.1 km

SITE GEOLOGY: Station underlain by Miocene marine sandstone and shale of San Pablo Group at northern closure of south-plunging east-dipping overturned syncline. Pliocene tuff (Lawlor tuff-?) exposed locally between San Pablo rocks and overlying Orinda Formation.

TRACE EVALUATION

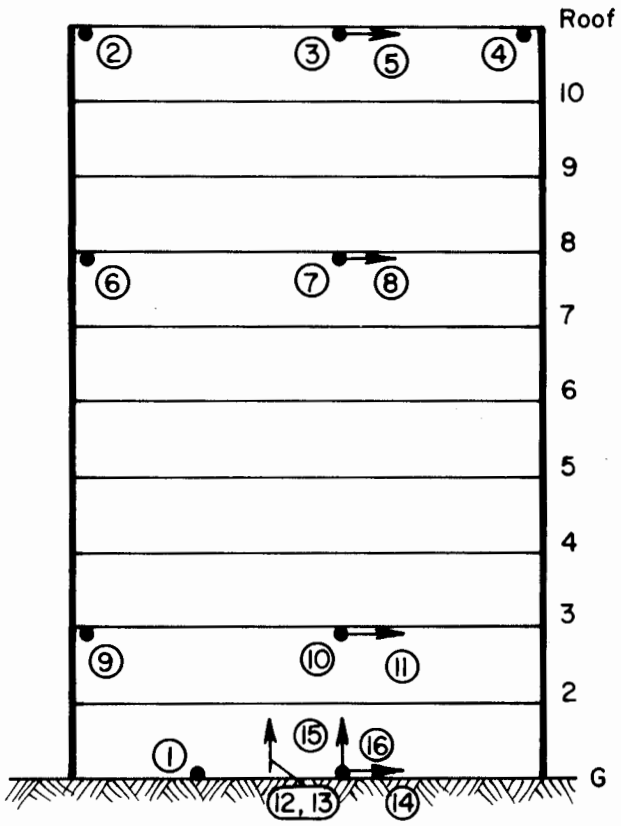
Trace (from top)	Orientation	Sensitivity (mm/g)	Nat Freq (Hz)	Damping (% crit)	Peak Accel (% g)
14	S	17.6	26.3	60	+2.7, -2.7
15	Up	17.7	26.1	59	+2.3, -2.3
16	E	18.5	26.2	58	+3.1, -2.8
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -

Structural orientation reference: North = 347 °

OSMS Rev 4/9/80

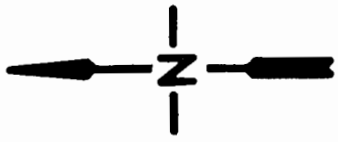
WALNUT CREEK-FIDELITY SAVINGS

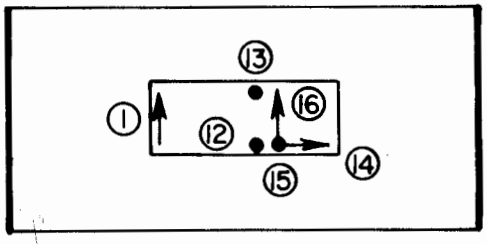
Strong-Motion Instrumentation Scheme



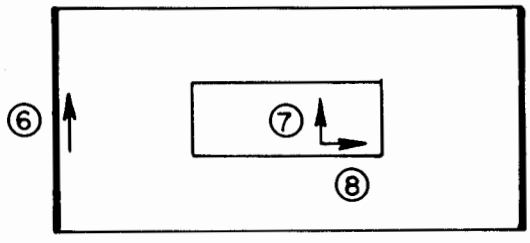
Trace Order		Location
1	—	N core wall at ground slab
2	—	Wall at roof slab
3	—	Top side roof slab
4	—	Wall at roof slab
5	—	Top side roof slab
6	}	Underside 8th floor slab
7		
8		
9	}	Underside 3rd floor slab
10		
11		
12	—	W core wall at ground slab
13	—	E core wall at ground slab
14	}	SMA-1 on ground floor slab
15		
16		

Starters	
Vertical	Ground floor slab
Horizontal	Roof deck

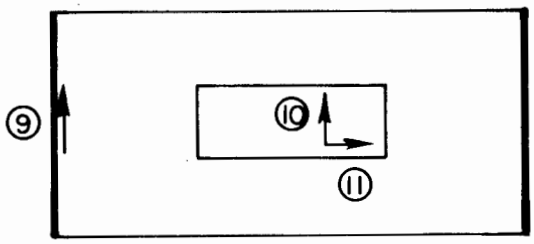




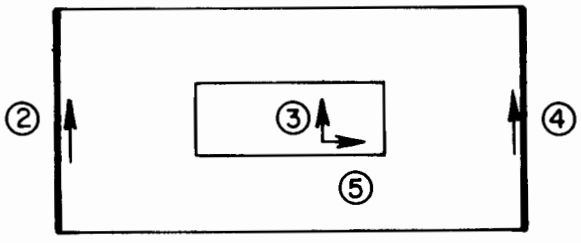
Ground Floor Plan



8th floor



3rd floor



Roof

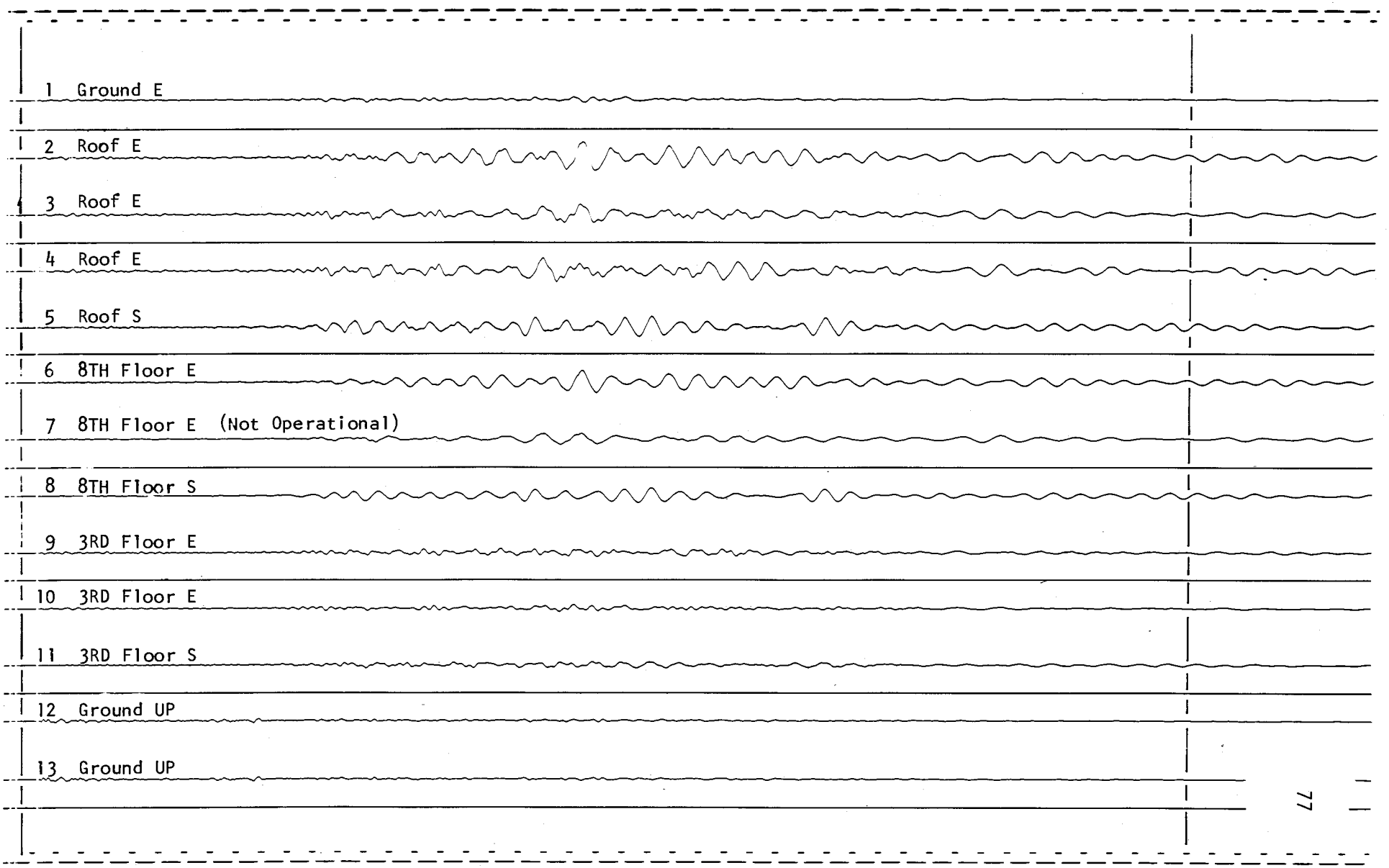
Walnut Creek-Fidelity Savings
37.907°N-122.065°W
CR-1 #194 Ch 13 (16)
CDMG #364

Livermore EQ
24Jan80 1100 PST (1900 UTC)
37.84°N-121.80°W
Mag 5.9

Senitivities mm/g

1	+18.0	4	+18.2	7	+18.0	10	+17.6
	-17.5		-17.8		-17.6		-17.9
2	+18.3	5	+17.8	8	+17.7	11	+17.7
	-18.2		-17.7		-17.6		-17.8
3	+18.2	6	+17.8	9	+17.5	12	+17.1
	-17.8		-17.8		-17.6		-17.4
13	+17.7						
	-17.6						

Copy Scale (1 cm)
Film Speed =
2 time mark/sec



Walnut Creek-Fidelity Savings
37.907°N-122.065°W
SMA-1 #3490 Ch 3 (16)
CDMG #364

Livermore EQ
24Jan80 1100 PST (1900 UTC)
37.84°N-121.80°W
Mag 5.9

Sensitivities mm/g
14 17.6
15 17.7
16 18.5

Copy Scale (1 cm)
Film Speed = 2 time mark/sec

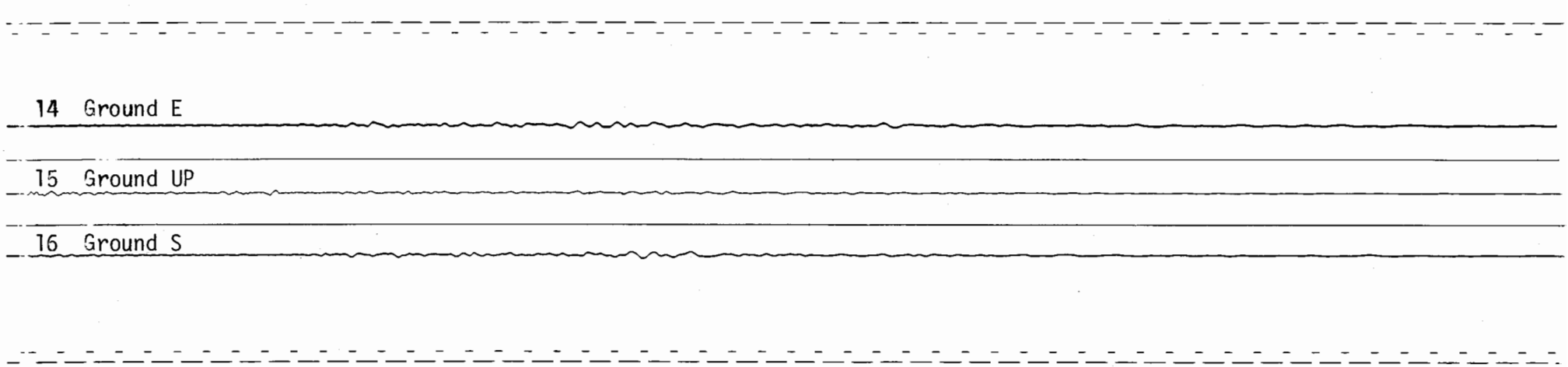


TABLE VI

Structural response and station data for CDMG instrumented structures that recorded the 26 January 1980 Livermore earthquake. Stations listed in alphabetical order.

No.	Station name	Coordinates	Structure Type/Size	Instrument Location(s)	Acceleration Max(g)	Loc.
183	Briones Dam	37.55 N 122.21 W	earthfill dam	L abutment L&C crest	0.04 0.07 0.06	L abut L crest C crest
188	El Cerrito (Capwell's)	37.899 N 122.298 W	2-story & penthouse building	ground level roof	0.02 0.03	grnd roof
354	Hayward (CSUH Admin. Bldg)	37.85 N 121.78 W	13-story building	basement 1st, 2nd, 5th roof	0.06 0.20	grnd roof
225	Oakland (Calrus Bldg)	37.742 N 122.148 W	3-story building	ground floor roof	0.02 0.12	grnd roof
224	Oakland (Title Insurance & Trust)	37.806 N 122.267 W	2-story & penthouse building	ground floor roof	0.03 0.09	grnd roof
348	Pleasant Hill (Citizens Savings)	37.946 N 122.060 W	3-story building	ground floor 3rd, roof	0.06 0.12	grnd roof
263	Redwood City (Canada College)	37.45 N 122.27 W	3-story building	ground floor roof	<0.01 0.02	grnd roof
355	San Jose (Great Western Savings)	37.381 N 121.883 W	10-story & 1 basement bldg	basement 2nd, 5th roof	0.01 0.03	grnd roof
356	San Jose (Town Park Towers)	37.381 N 121.888 W	10-story building	ground floor 6th, roof	0.01 0.02	grnd roof
187	San Ramon (Eastman Kodak Building)	37.729 N 121.928 W	1-story building	ground floor roof	0.28 0.47	grnd roof
235	Saratoga (West Valley Community College)	37.262 N 122.009 W	1-story building	ground floor roof	0.01 0.03	grnd roof
261	So. San Francisco (Kaiser Medical Building)	37.660 N 122.439 W	4-story building	basement 1st, 2nd roof	0.01 0.07	grnd roof
364	Walnut Creek (Fidelity Savings)	37.907 N 122.065 W	10-story building	ground floor 3rd, 8th roof	0.06 0.21	grnd roof

STRONG MOTION RECORD DATA

STATION: Name Hayward - CSUH Administration Building
Address Calif. State University, Hayward
Hayward, California
County Alameda Elevation 142 m
CDMG 354 Latitude 37.655 °N
USGS - Longitude 121.056 °W

INSTRUMENT: Type (Traces)	Serial Number	Date Installed	Date Removed
CR-1 (13)	188	3/16/79	in place

EARTHQUAKE: Name (Region) Livermore
Date 26 Jan 80 (UTC) 0233 Epicentral Distance 33.6 km

SITE GEOLOGY: Station underlain by altered and sheared metavolcanic rock as fault sliver within Hayward - Chabot fault zone. Great Valley rocks exposed in hills east of station and alluvium underlies San Francisco Bay region to west.

TRACE EVALUATION

Trace (from top)	Orientation	Sensitivity (mm/g)	Nat Freq (Hz)	Damping (% crit)	Peak Accel (% g)
1	N	+17.4 -17.0	52.6	63	+ 6.3, - 4.1
2	N	+17.6 -17.4	50.1	63	+19.3, -20.1
3	N	+17.4 -17.3	51.1	64	+16.7, -13.9
4	E	+17.3 -17.1	51.4	64	+ 4.6, - 6.4
5	N	+17.6 -17.6	50.4	63	+ 9.7, - 5.7
6	E	+17.4 -17.3	50.6	65	+ 2.3, - 2.9
7	N	+17.2 -17.3	53.0	64	+ 8.7, - 5.2
8	N	+17.8 -17.8	50.3	62	+ 5.9, - 3.9
9	E	+17.2 -17.0	53.7	67	+ 2.9, - 4.1
10	N	+17.4 -17.8	51.6	65	+ 7.5, - 3.4
11	N	+17.3 -17.3	50.9	64	+ 4.6, - 3.5
12	E	+16.8 -17.4	50.7	66	+ 2.4, - 2.9
13	N	+17.1 -17.6	52.7	67	+ 1.8, - 1.1

Structural orientation reference: North = 305 °

STRONG MOTION RECORD DATA

STATION: Name Hayward - CSUH Administration Building
Address Calif. State University, Hayward
Hayward, California
County Alameda Elevation 142 m
CDMG 354 Latitude 37.655 °N
USGS - Longitude 122.056 °W

INSTRUMENT: Type (Traces)	Serial Number	Date Installed	Date Removed
SMA-1 (3)	3486	3/16/79	3/28/79
SMA-1 (3)	3489	3/28/79	in place

EARTHQUAKE: Name (Region) Livermore
Date 26 Jan 80 (UTC) 0233 Epicentral Distance 33.6 km

SITE GEOLOGY: Station underlain by altered and sheared metavolcanic rock as fault sliver within Hayward - Chabot fault zone. Great Valley rocks exposed in hills east of station and alluvium underlies San Francisco Bay region to west.

TRACE EVALUATION

Trace (from top)	Orientation	Sensitivity (mm/g)	Nat Freq (Hz)	Damping (% crit)	Peak Accel (% g)
14	E	18.7	25.1	56	+3.2, -1.6
15	Up	19.5	25.2	60	+2.1, -1.0
16	N	18.6	25.7	59	+6.2, -4.6
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -

Structural orientation reference: North = 305 °

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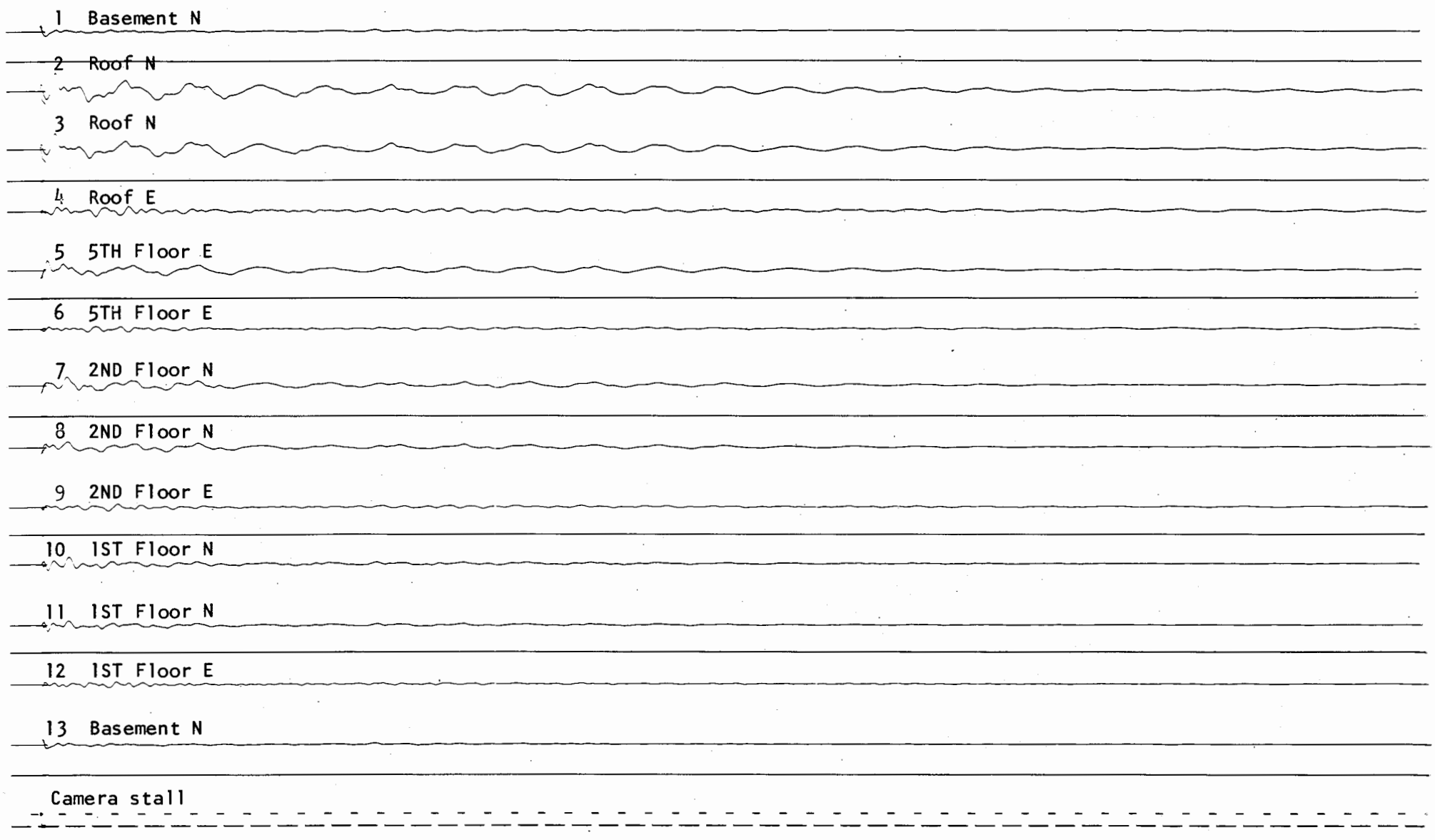
Hayward-CSUH Adm Bldg
37.655°N-122.056°W
CR-1 #188 Ch 13 (16)
CDMG #354

Livermore EQ
26Jan80 1833 PST (0233 UTC)
37.76°N-121.70°W
Mag 5.2

Sensitivities mm/g

1	+17.4	4	+17.3	7	+17.2	10	+17.4	13	+17.1
	-17.0		-17.1		-17.3		-17.8		-17.6
2	+17.6	5	+17.6	8	+17.8	11	+17.3		
	-17.4		-17.6		-17.8		-17.3		
3	+17.4	6	+17.4	9	+17.2	12	+16.8		
	-17.3		-17.3		-17.0		-17.4		

Copy Scale (1 cm)
Film Speed =
2 time mark/sec



Hayward-CSUH Adm Bldg
37.655°N-122.056°W
SMA-1 #3489 Ch 3 (16)
CDMG #354

Livermore EQ
26Jan80 1833 PST (0233 UTC)
37.76°N-121.70°W
Mag 5.2

Sensitivities mm/g
14 18.7
15 19.5
16 18.6

Copy Scale (1 cm)
Film Speed = 2 time mark/sec

14 Basement E

15 Basement UP

16 Basement N

STRONG MOTION RECORD DATA

STATION: Name Pleasant Hill - Citizens Savings
Address 2255 Contra Costa Blvd.
Pleasant Hill, California
County Contra Costs Elevation 16 m
CDMG 348 Latitude 37.946 °N
USGS - Longitude 122.060 °W

INSTRUMENT:

Type (Traces)	Serial Number	Date Installed	Date Removed
CR-1 (12)	179	1/16/79	in place

EARTHQUAKE: Name (Region) Livermore
Date 26 Jan 80 (UTC) 0233 Epicentral Distance 38.1 km

SITE GEOLOGY: Station underlain by Quaternary Valley alluvium (∿50m-?) deposited by Walnut Creek. The alluvium overlies at depth early to middle Cenozoic marine rocks of several formations.

TRACE EVALUATION

Trace (from top)	Orientation	Sensitivity (mm/g)	Nat Freq (Hz)	Damping (% crit)	Peak Accel (% g)
1	Up	+18.3 -18.0	51.9	66	+ 1.6, - 1.7
2	N	+17.9 -17.6	52.5	65	+ 5.6, - 6.8
3	E	+17.8 -18.1	53.4	65	+ 6.7, - 6.6
4	E	+18.1 -17.9	53.3	65	+12.2, -12.3
5	E	+18.3 -18.0	52.0	64	+ 6.0, - 6.1
6	N	+18.1 -18.2	52.1	64	+ 5.0, - 3.8
7	E	+17.4 -17.5	52.8	64	+ 4.6, - 5.1
8	E	+17.2 -17.3	51.5	62	+ 9.9, - 9.2
9	E	+17.3 -17.8	52.1	67	+ 4.0, - 3.9
10	E	+17.2 -17.3	51.9	64	+ 4.1, - 2.9
11	E	+17.1 -17.9	51.9	63	+ 5.8, - 3.3
12	N	+17.6 -18.0	52.6	65	+ 2.8, - 3.3
					+ -

Structural orientation reference: North = 360 °

OSMS Rev 4/9/80

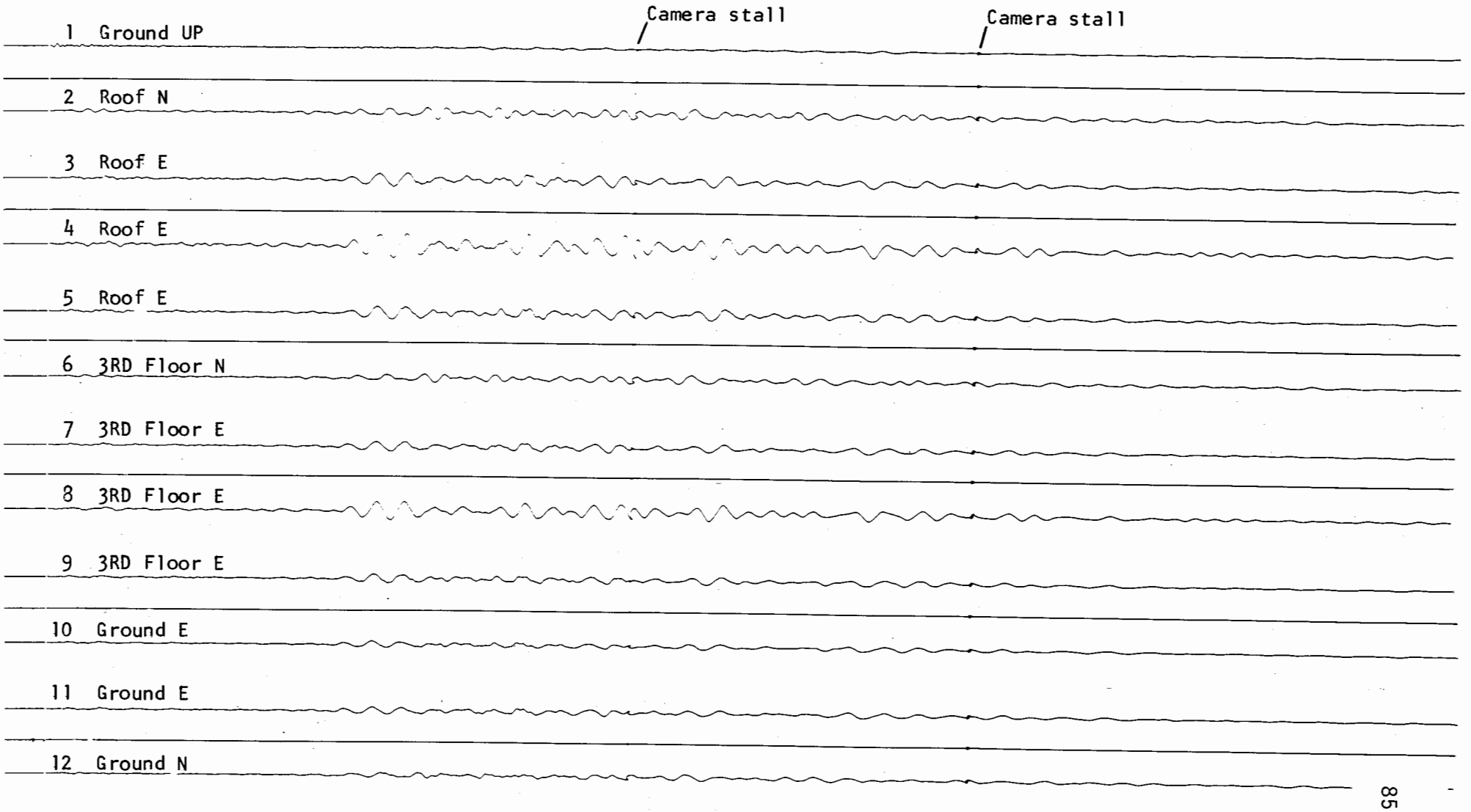
Pleasant Hill-Citizens Savings
37.946°N-122.060°W
CR-1 #179 Ch 12
CDMG #348

Livermore EQ
26Jan80 1833 PST (0233 UTC)
37.76°N-121.70°W
Mag 5.2

Sensitivities mm/g

1 +18.3	4 +18.1	7 +17.4	10 +17.2
-18.0	-17.9	-17.5	-17.3
2 +17.9	5 +18.3	8 +17.2	11 +17.1
-17.6	-18.2	-17.3	-17.9
3 +17.8	6 +18.1	9 +17.3	12 +17.6
-18.1	-18.2	-17.8	-18.0

Copy Scale (1 cm)
Film Speed =
2 time mark/sec



STRONG MOTION RECORD DATA

STATION: Name San Ramon - Eastman Kodak Building
Address 1900 Alcosta Blvd.
San Ramon, California
County Contra Costa Elevation 107 m
CDMG 187 Latitude 37.729 °N
USGS - Longitude 121.928 °W

INSTRUMENT:

Type (Traces)	Serial Number	Date Installed	Date Removed
CR-1	105	2/25/75	in place

EARTHQUAKE: Name (Region) Livermore
Date 26 Jan 80 (UTC) 0233 Epicentral Distance 20.5 km

SITE GEOLOGY: Station underlain by dissected Quaternary alluvium (~50m-?) of San Ramon Valley. Pliocene non-marine Orinda Formation underlies alluvium at depth. San Ramon Valley defines trace of Calaveras fault zone.

TRACE EVALUATION

Trace (from top)	Orientation	Sensitivity (mm/g)	Nat Freq (Hz)	Damping (% crit)	Peak Accel (% g)
1	N	19.4	51.8	66	+30.9, -47.4
2	N	19.2	50.6	67	+38.0, -24.5
3	E	18.9	51.2	66	+15.9, -12.7
4	S	18.2	53.5	66	+28.0, -17.0
5	Up	19.1	53.9	67	+ 3.1, - 4.2
6	W	19.1	52.5	64	+ 9.4, - 8.4
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -

Structural orientation reference: North = 325 °

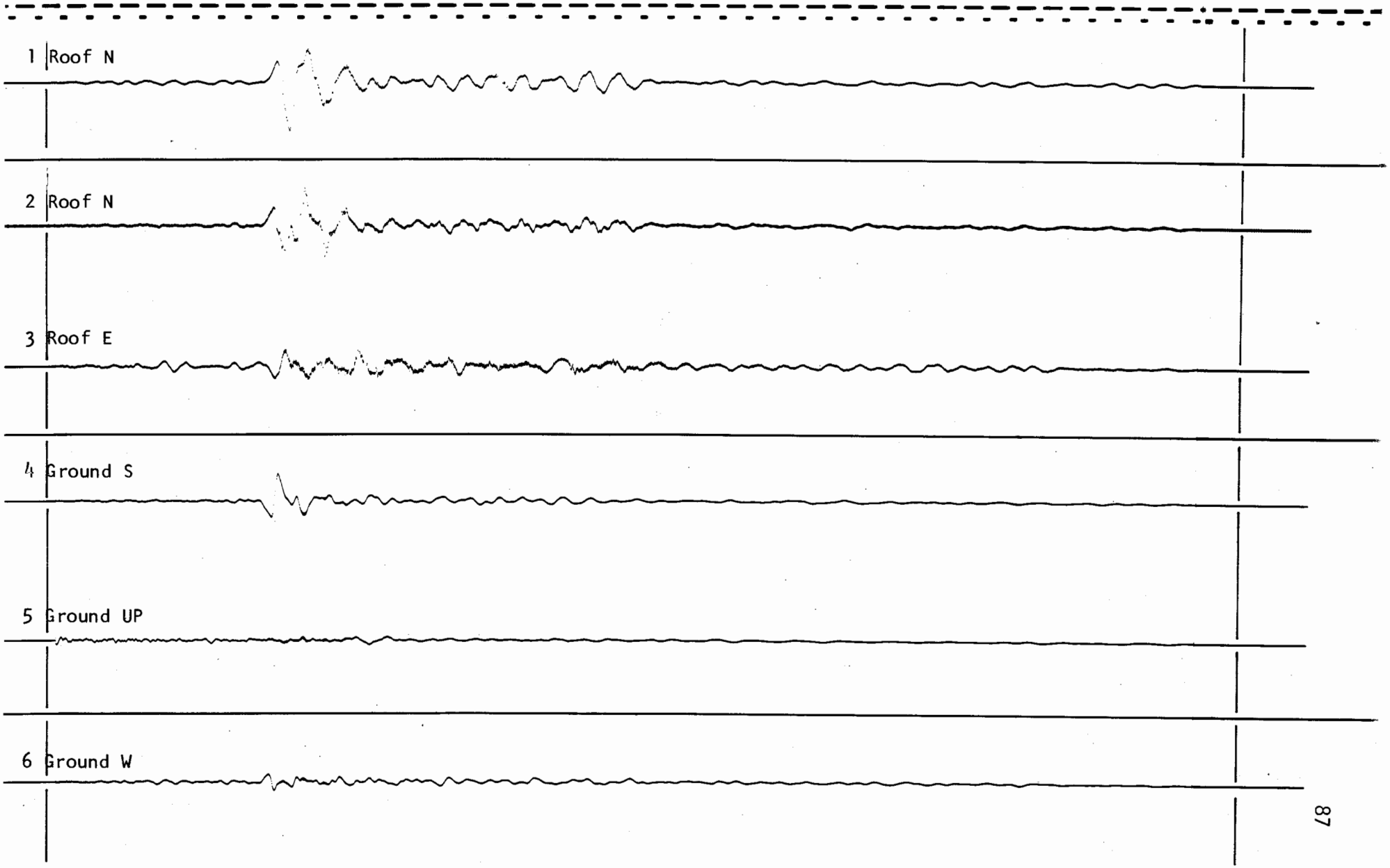
OSMS Rev 4/9/80

San Ramon-Eastman Kodak Bldg
37.729°N-121.928°W
CR-1 #105 Ch 6
CDMG #187

Livermore EQ
26Jan80 1833 PST (0233 UTC)
37.76°N-121.70°W
Mag 5.2

Sensitivities mm/g
1 19.4 4 18.2
2 19.2 5 19.1
3 18.9 6 19.1

Copy Scale (1 cm)
Film Speed = 2 time mark/sec



STRONG MOTION RECORD DATA

STATION: Name Walnut Creek - Fidelity Savings

Address 1990 N. California Blvd.

Walnut Creek, California

County Contra Costa Elevation 52 m

CDMG 364 Latitude 37.907 °N

USGS - Longitude 122.065 °W

INSTRUMENT: Type (Traces)	Serial Number	Date Installed	Date Removed
CR-1 (13)	194	12/14/79	in place

EARTHQUAKE: Name (Region) Livermore

Date 26 Jan 80 (UTC) 0233 Epicentral Distance 35.8 km

SITE GEOLOGY: Station underlain by Miocene marine sandstone and shale of San Pablo Group at northern closure of south-plunging east-dipping overturned syncline. Pliocene tuff (Lawlor tuff-?) exposed locally between San Pablo rocks and overlying Orinda Formation.

TRACE EVALUATION

Trace (from top)	Orientation	Sensitivity (mm/g)	Nat Freq (Hz)	Damping (% crit)	Peak Accel (% g)
1	E	+18.0 -17.5	52.3	64	+ 4.7, - 4.3
2	E	+18.3 -18.2	51.8	64	+16.9, -20.9
3	E	+18.2 -17.8	51.1	64	+19.0, -18.5
4	E	+18.2 -17.8	50.4	63	+19.5, -18.3
5	S	+17.8 -17.7	52.2	65	+12.9, -16.4
6	E	+17.8 -17.8	51.3	64	+11.8, -12.9
7	E	+18.0 -17.6	51.8	63	+11.7, -11.9
8	S	+17.7 -17.6	50.7	63	+ 9.6, - 9.7
9	E	+17.5 -17.6	51.2	64	+ 5.7, - 6.3
10	E	+17.6 -17.9	51.6	67	+ 5.7, - 4.2
11	S	+17.7 -17.8	50.8	62	+ 7.3, - 5.3
12	Up	+17.1 -17.4	51.7	64	+ 1.8, - 1.7
13	Up	+17.7 -17.6	52.9	63	+ 1.7, - 1.1

Structural orientation reference: North = 347 °

STRONG MOTION RECORD DATA

STATION: Name Walnut Creek - Fidelity Savings
Address 1990 N. California Blvd.
Walnut Creek, California
County Contra Costa Elevation 52 m
CDMG 364 Latitude 37.907 °N
USGS - Longitude 122.065 °W

INSTRUMENT: Type (Traces)	Serial Number	Date Installed	Date Removed
SMA-1 (3)	3490	12/14/79	in place

EARTHQUAKE: Name (Region) Livermore
Date 26 Jan 80 (UTC) 0233 Epicentral Distance 35.8 km

SITE GEOLOGY: Station underlain by Miocene marine sandstone and shale of San Pablo Group at northern closure of south-plunging east-dipping overturned syncline. Pliocene tuff (Lawlor tuff-?) exposed locally between San Pablo rocks and overlying Orinda Formation.

TRACE EVALUATION

Trace (from top)	Orientation	Sensitivity (mm/g)	Nat Freq (Hz)	Damping (% crit)	Peak Accel (% g)
14	E	18.5	26.2	58	+ 5.9, - 4.3
15	Up	17.7	26.1	59	+ 2.0, - 1.1
16	S	17.6	26.3	60	+ 5.4, - 4.3
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -
					+ -

Structural orientation reference: North = 347 °

OSMS Rev 4/9/80

Walnut Creek-Fidelity Savings
37.907°N-122.065°W
CR-1 #194 Ch 13 (16)
CDMG #364

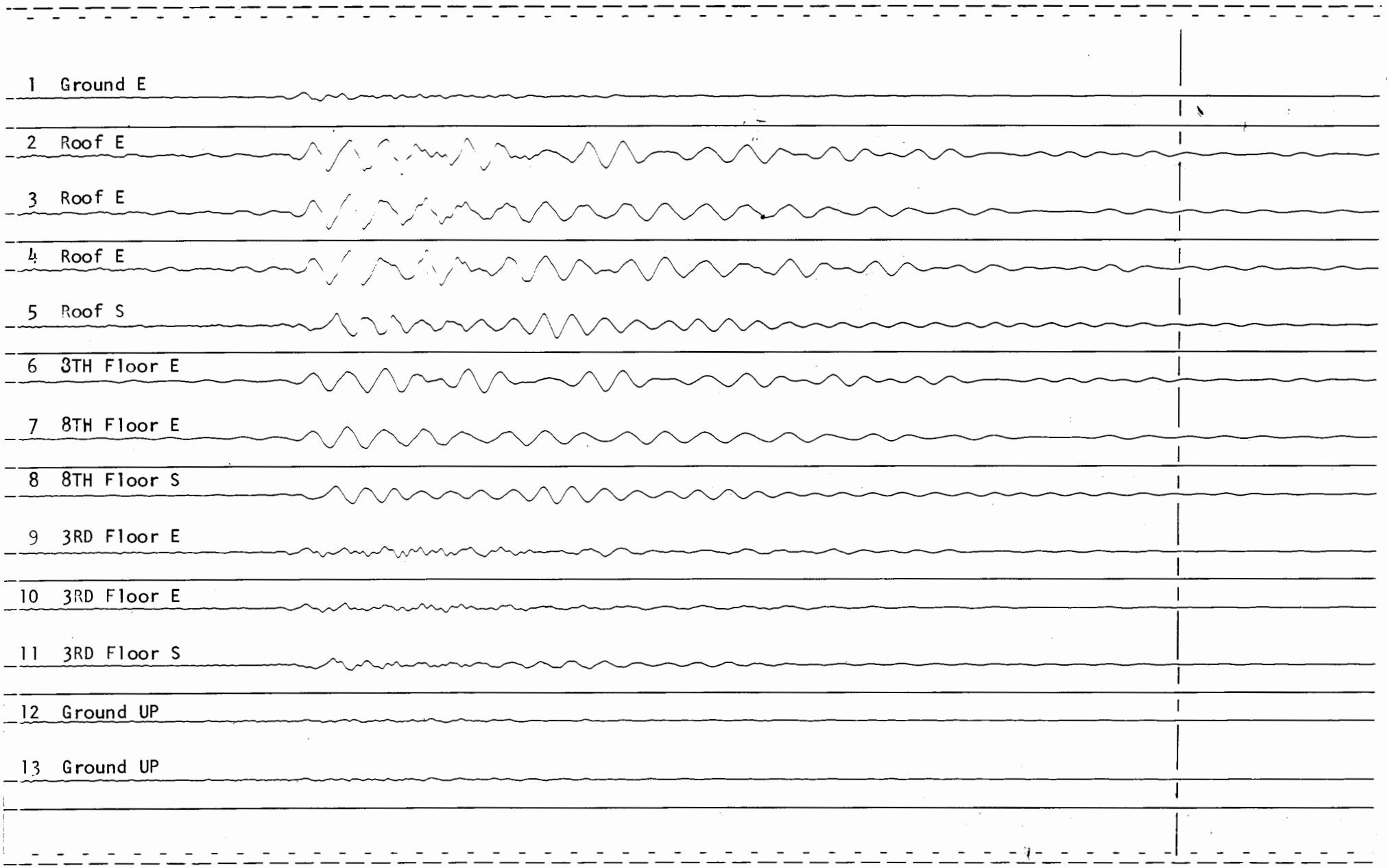
Livermore EQ
26Jan80 1833 PST (0233 UTC)
37.76°N-121.70°W
Mag 5.2

Sensitivities mm/g

1	+18.0	4	+18.2	7	+18.0	10	+17.6
	-17.5		-17.8		-17.6		-17.9
2	+18.3	5	+17.8	8	+17.7	11	+17.7
	-18.2		-17.7		-17.6		-17.8
3	+18.2	6	+17.8	9	+17.5	12	+17.1
	-17.8		-17.8		-17.6		-17.4
13	+17.7						
	-17.4						

Copy Scale
(1 cm)
Film Speed =
2 time mark/sec

90



Walnut Creek-Fidelity Savings
37.907°N-122.065°W
SMA-1 #3490 Ch 3 (16)
CDMG #364

Livermore EQ
26Jan80 1833 PST (0233 UTC)
37.76°N-121.70°W
Mag 5.2

Sensitivities mm/g
14 17.6
15 17.7
16 17.6

Copy Scale (1 cm)
Film Speed =
2 time mark/sec